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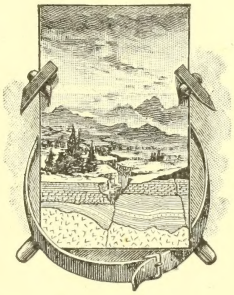
DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPERS

Nos. 284-286



WASHINGTON

GOVERNMENT PRINTING OFFICE

1912

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Water-supply paper 284; Surface water supply of United States, 1910, pt. 4, St. Lawrence River basin.

Same 285; Surface water supply of United States, 1910, pt. 5, Hudson Bay and upper Mississippi River.

Same 286; Surface water supply of United States, 1910, pt. 6, Missouri River basin.

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPER 284

SURFACE WATER SUPPLY OF THE UNITED STATES

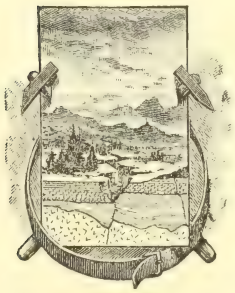
1910

PART IV. ST. LAWRENCE RIVER BASIN

PREPARED UNDER THE DIRECTION OF M. O. LEIGHTON

BY

C. C. COVERT, A. H. HORTON
AND R. H. BOLSTER



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SURFACE WATER SUPPLY OF ST. LAWRENCE RIVER BASIN, 1910.

By C. C. Covert, A. H. Horton, and R. H. Bolster.

INTRODUCTION.

AUTHORITY FOR INVESTIGATIONS.

This volume contains results of measurements of the flow of certain streams in the United States. The work was performed by the United States Geological Survey, either independently or in cooperation with private or State organizations. The organic law of the Geological Survey (Stat. L., vol. 20, p. 394) contains the following paragraph:

Provided, That this officer [the Director] shall have the direction of the geological survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

As water is the most abundant and most valuable of the minerals the investigation of water resources is authorized under the provision for examining mineral resources. The work has been supported since the fiscal year ending June 30, 1895, by appropriations in successive sundry civil bills passed by Congress under the following item:

For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

The various appropriations that have been made for this purpose are as follows:

Annual appropriations for the fiscal year ending June 30—

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000
1911	150,000

SCOPE OF INVESTIGATIONS.

These investigations are not complete nor are they inclusive of all the streams that might purposefully be studied. The scope of the work is limited by the appropriations available. The field covered is the widest and the character of the work is believed to be the best possible under the controlling conditions. The work would undoubtedly have greater scientific importance and ultimately be of more practical value if the money now expended for wide areas were concentrated on a few small drainage basins; but such a course is impossible because general appropriations made by Congress are applicable to all parts of the country. Each part demands its proportionate share of the benefits.

It is essential that records of stream flow shall be kept during a period of years long enough to determine within reasonable limits the entire range of flow from the absolute maximum to the absolute minimum. The length of such a period manifestly differs for different streams. Experience has shown that the records for some streams should cover 5 to 10 years, and those for other streams 20 years or even more, the limit being determined by the relative importance of the stream and the interdependence of the results with other long-time records on adjacent streams.

In the performance of this work an effort is made to reach the highest degree of precision possible with a rational expenditure of time and a judicious expenditure of a small amount of money. In all engineering work there is a point beyond which refinement is needless and wasteful, and this statement applies with especial force to stream-flow measurements. It is confidently believed that the stream-flow data presented in the publications of the survey are in general sufficiently accurate for all practical purposes. Many of the records are, however, of insufficient length, owing to the unforeseen reduction of appropriations and consequent abandonment of stations. All persons are cautioned to exercise the greatest care in using such incomplete records.

Records have been obtained at nearly 2,000 different points in the United States. The surface water supply of small areas in Seward Peninsula and the Yukon-Tanana region, Alaska, and in Hawaii has also been investigated. During 1910 regular gaging stations were maintained by the survey and cooperating organizations at about 1,100 points in the United States, and many discharge measurements were made at other points. Data were also obtained in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country, and will be made available in the regular surface water-supply papers and in special papers from time to time.

PUBLICATIONS.

The data on stream flow collected by the United States Geological Survey have appeared in the annual reports, bulletins, and water-supply papers. Owing to natural processes of evolution and to changes in governmental requirements the character of the work and the territory covered by these different publications have varied greatly. For the purpose of uniformity in the presentation of reports a general plan has been agreed upon by the United States Reclamation Service, the United States Forest Service, the United States Weather Bureau, and the United States Geological Survey, according to which the area of the United States has been divided into 12 parts, whose boundaries coincide with certain natural drainage lines. The areas so described are indicated by the following list of papers on surface water supply for 1910. The dividing line between the north Atlantic and south Atlantic drainage areas lies between York and James rivers.

Papers on surface water supply of the United States, 1910.

Part.	No.	Title.
I	281	North Atlantic coast.
II	282	South Atlantic coast and eastern Gulf of Mexico.
III	283	Ohio River basin.
IV	284	St. Lawrence River basin.
V	285	Upper Mississippi River and Hudson Bay basins
VI	286	Missouri River basin.
VII	287	Lower Mississippi River basin.
VIII	288	Western Gulf of Mexico.
IX	289	Colorado River basin.
X	290	Great Basin.
XI	291	Pacific coast in California.
XII	292	North Pacific coast.

The following table gives the character of data regarding stream flow at regular stations to be found in the various publications of the United States Geological Survey, exclusive of special papers:

Stream-flow data in reports of the United States Geological Survey.

[A=Annual Report; B=Bulletin; WS=Water-Supply Paper.]

Report.	Character of data.	Year.
10th A, pt. 2	Descriptive information only	
11th A, pt. 2	Monthly discharge	1884 to Sept. 1890.
12th A, pt. 2	do	1884 to June 30, 1891.
13th A, pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th A, pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th A, pt. 2	Descriptive information only	
B 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
WS 11	Gage heights (also gage heights for earlier years)	1896.
18th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for earlier years).	1895 and 1896.
WS 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.

Stream-flow data in reports of the United States Geological Survey—Continued.

Report.	Character of data.	Year.
WS 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
WS 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
WS 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th A, pt. 4	Monthly discharge (also for many earlier years)	1898.
WS 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st A, pt. 4	Monthly discharge	1899.
WS 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d A, pt. 4	Monthly discharge	1900.
WS 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
WS 75	Monthly discharge	1901.
WS 82 to 85	Complete data	1902.
WS 97 to 100	....do	1903.
WS 124 to 135	....do	1904.
WS 165 to 178	....do	1905.
WS 201 to 214	Complete data, except descriptions	1906.
WS 241 to 252	Complete data	1907–8.
WS 261 to 272	....do	1909.
WS 281 to 292	....do	1910.

NOTE.—No data regarding stream flow are given in the fifteenth and seventeenth annual reports.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing records prior to 1904 has been published in Water-Supply Paper 119.

The first table which follows gives, by years and drainage basins, the number of the papers on surface water supply published from 1899 to 1910. Wherever the data for a drainage basin appear in two papers the number of one is placed in parentheses and the portion of the basin covered by that paper is indicated in the second table. For example, in 1904 the data for Missouri River were published in Water-Supply Papers 130 and 131, and the portion of the records contained in Water-Supply Paper 131, as indicated by the second table, is that relating to Platte and Kansas Rivers.

Numbers of water-supply papers containing results of stream measurements, 1899–1910.

	1899 [a]	1900 [b]	1901	1902	1903
Atlantic coast and eastern Gulf of Mexico:					
New England rivers	35	47	65, 75	82	97
Hudson River to Delaware River, inclusive	35	47, (48)	65, 75	82	97
Susquehanna River to York River, inclusive	35	48	65, 75	82	97
James River to Yadkin River, inclusive	(35), 36	48	65, 75	(82), 83	(97), 98
Santee River to Pearl River, inclusive	36	48	65, 75	83	98
St. Lawrence River	36	49	65, 75	(82), 83	97
Hudson Bay	.....	.....	66, 75	85	100
Mississippi River:					
Ohio River	36	48, (49)	65, 75	83	98
Upper Mississippi River	36	49	65, 75	83	98, (99)
Missouri River	(36), 37	49, (50)	66, 75	84	99
Lower Mississippi River	37	50	{ (65), 66, 75 }	(83), 84	(98), 99
Western Gulf of Mexico	37	50	66, 75	84	99
Pacific coast and Great Basin:					
Colorado River	(37), 38	50	66, 75	85	100
Great Basin	38, (39)	51	66, 75	85	100
South Pacific coast to Klamath River, inclusive	(38), 39	51	66, 75	85	100
North Pacific coast	38	51	66, 75	85	100

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39.
[b] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52.

Numbers of water-supply papers containing results of stream measurements, 1899–1910— Continued.

	1904	1905	1906	1907–8	1909	1910
Atlantic coast and eastern Gulf of Mexico:						
New England rivers	124	165	201	241	261	281
Hudson River to Delaware River, inclusive	125	166	202	241	261	281
Susquehanna River to York River, inclusive	126	167	203	241	261	281
James River to Yadkin River, inclusive	126	167	203	242	262	282
Santee River to Pearl River, inclusive	127	168	204	242	262	282
St. Lawrence River	129	170	206	244	264	284
Hudson Bay	130	171	207	245	265	285
Mississippi River:						
Ohio River	128	169	205	243	263	283
Upper Mississippi River	128, (130)	171	207	245	265	285
Missouri River	130, (131)	172	208	246	266	286
Lower Mississippi River	(128), 131	(169), 173	(205), 209	247	267	287
Western Gulf of Mexico	132	174	210	248	268	288
Pacific coast and Great Basin:						
Colorado River	133, (134)	175, (177)	211, (213)	249, (251)	269, (271)	289
Great Basin	133, (134)	176, (177)	212, (213)	250, (251)	270 (271)	290
South Pacific coast to Klamath River, inclusive	134	177	213	251	271	291
North Pacific coast	135	(177), 178	214	252	272	292

Numbers of water-supply papers containing data covering portions of drainage basins.

No.	River basin.	Tributaries included.
35	James	
36	Missouri	Gallatin.
37	Colorado	Green, Gunnison, Grand above junction with Gunnison.
38	Sacramento	Except Kings and Kern.
39	Great Basin	Mohave.
48	Delaware	Wissahickon and Schuylkill.
49	Ohio	Scioto.
50	Missouri	Loup and Platte near Columbus, Nebr. All tributaries below junction with Platte.
65	Lower Mississippi	Yazoo.
82	James	
	St. Lawrence	Lake Ontario, tributaries to St. Lawrence River proper.
83	Lower Mississippi	Yazoo.
97	James	
98	Lower Mississippi	Do.
99	Upper Mississippi	Tributaries from the west.
128	Lower Mississippi	Yazoo.
130	Upper Mississippi	Tributaries from the west.
131	Missouri	Platte, Kans.
134	Colorado	Data near Yuma, Ariz., repeated.
	Great Basin	Susan, Owens, Mohave.
169	Lower Mississippi	Yazoo.
177	Colorado	Below junction with Gila.
	Great Basin	Susan repeated, Owens, Mohave.
	North Pacific coast	Rogue, Umpqua, Siletz.
205	Lower Mississippi	Yazoo, Homochitto.
213	Colorado	Data at Hardyville repeated; at Yuma, Salton Sea.
	Great Basin	Owens, Mohave.
251	Colorado	Yuma and Salton Sea stations repeated.
271	Great Basin	Owens River Basin.

The order of treatment of stations in any basin in these papers is downstream. The main stem of any river is determined by measuring or estimating the drainage area; that is, the headwater stream having the largest drainage area is considered the continuation of the main stream, and local changes in name and lake surface are disregarded. Records for all stations from the source to the mouth of the

main stem of the river are presented first, and records for the tributaries in regular order from source to mouth follow, all records in each tributary basin being given before those of the next basin below.

The exceptions to this rule occur in the records for Mississippi River, which are given in four parts, as indicated above, and in the records for large lakes, where it is simpler to take up the streams in regular order around the rim of the lake than to cross back and forth over the lake surface.

DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. The units used in this series of reports are second-feet, second-feet per square mile, and run-off in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed by the use of the factors given in the following table of equivalents.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work.

CONVENIENT EQUIVALENTS.

The following is a list of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of Mar. 23, 1901).

1 second-foot equals 38.4 Colorado miner's inches.

1 second-foot equals 40 Arizona miner's inches.

1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,317 gallons for one day.

1 second-foot equals 6.23 British imperial gallons per second.

1 second-foot for one year covers 1 square mile 1.131 feet or 13.572 inches deep.
1 second-foot for one year equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot for one day covers 1 square mile 0.03719 inch deep.
1 second-foot for one 28-day month covers 1 square mile 1.041 inches deep.
1 second-foot for one 29-day month covers 1 square mile 1.079 inches deep.
1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.
1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep
1 second-foot for one day equals 1.983 acre-feet.
1 second-foot for one 28-day month equals 55.54 acre-feet.
1 second-foot for one 29-day month equals 57.52 acre-feet.
1 second-foot for one 30-day month equals 59.50 acre-feet.
1 second-foot for one 31-day month equals 61.49 acre-feet.
100 California miner's inches equals 18.7 United States gallons per second.
100 California miner's inches equals 96.0 Colorado miner's inches.
100 California miner's inches for one day equals 4.96 acre-feet.
100 Colorado miner's inches equals 2.60 second-feet.
100 Colorado miner's inches equals 19.5 United States gallons per second.
100 Colorado miner's inches equals 104 California miner's inches.
100 Colorado miner's inches for one day equals 5.17 acre-feet.
100 United States gallons per minute equals 0.223 second-feet.
100 United States gallons per minute for one day equals 0.442 acre-foot.
1,000,000 United States gallons per day equals 1.55 second-feet.
1,000,000 United States gallons equals 3.07 acre-feet.
1,000,000 cubic feet equals 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-foot.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.
1⅓ horsepower equals about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel realizing 80 per cent of theoretical power.

EXPLANATION OF DATA.

For each drainage basin there is given a brief general description covering such items as area, source, tributaries, topography, geology, forestation, rainfall, irrigation, storage, power, and other interesting or important facts.

For each regular current-meter gaging station the following data, so far as available, are given: Description of station, list of discharge measurements, table of daily gage heights, table of daily discharges, table of monthly and yearly discharges, and run-off. For stations located at weirs or dams the gage-height table is omitted.

In addition to statements regarding the location and installation of current-meter stations, the descriptions give information in regard to any conditions which may affect the constancy of the relation of gage height to discharge, covering such points as ice, logging, shifting channels, and backwater; also information regarding diversions which decrease the total flow at the measuring section. Statements are also made regarding the accuracy and reliability of the data.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, name of hydrographer, width and area of cross section, gage height, and discharge in second-feet.

The table of daily gage heights records the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. At most stations the gage is read in the morning and in the evening. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. All gage heights affected by the presence of ice in the streams or by backwater from obstructions are published as recorded, with suitable footnotes. The rating table is not applicable for such periods unless the proper corrections to the gage heights are known and applied. Attention is called to the fact that the zero of the gage is placed at an arbitrary datum and has no relation to zero flow or the bottom of the river. In general the zero is located somewhat below the lowest known flow, so that negative readings shall not occur.

The discharge measurements and gage heights are the base data from which rating tables, daily discharge tables, and monthly discharge tables are computed.

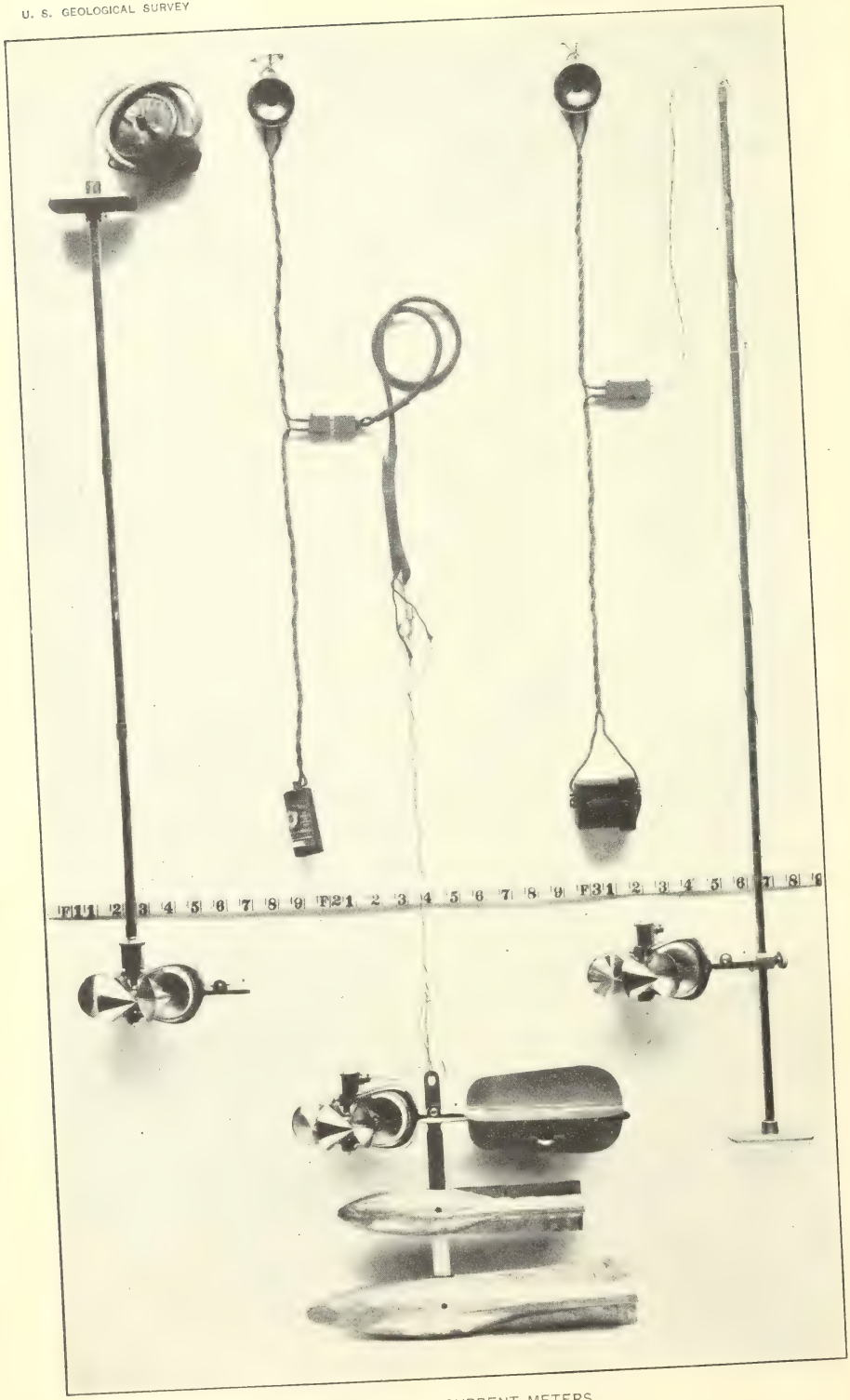
The rating table gives, either directly or by interpolation, the discharge in second-feet corresponding to every stage of the river recorded during the period for which it is applicable. It is not published in this report, but can be determined from the daily gage heights and daily discharges for the purpose of verifying the published results as follows:

First plot the discharge measurements for the current and earlier years on cross-section paper, with gage heights in feet as ordinates and discharge in second-feet as abscissas. Then tabulate a number of gage heights taken from the daily gage-height table for the complete range of stage given and the corresponding discharges for the days selected from the daily discharge table and plot the values on

A. FOR BRIDGE MEASUREMENT.

B. FOR WADING MEASUREMENT.

TYPICAL GAGING STATIONS.



SMALL PRICE CURRENT METERS.

cross-section paper. The last points plotted will define the rating curve used and will lie among the plotted discharge measurements. After drawing the rating curve, a table can be developed by scaling off the discharge in second-feet for each tenth foot of gage height. These values should be so adjusted that the first differences shall always be increasing or constant, except for known backwater periods.

The table of daily discharges gives the discharges in second-feet, corresponding to the observed gage heights as determined from the rating tables.

In the table of monthly discharge the column headed "Maximum" gives the mean flow, as determined from the rating table, for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the stage when the water surface was at crest height, and the corresponding discharge was consequently larger than given in the maximum column. Likewise, in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this the computations for the remaining columns, which are defined on page 12, are based.

The field methods used in the collection of the data presented in this series of reports are described in the introductory sections of Water-Supply Papers 261 to 272, inclusive, "Surface water supply of the United States, 1909." Plate I shows typical gaging stations, indicating the method of suspending the current meter; Plate II shows the various types of current meters [1] used in the work.

ACCURACY AND RELIABILITY OF FIELD DATA AND COMPARATIVE RESULTS.

The accuracy of stream-flow data depends primarily on the natural conditions at the gaging station and on the methods and care with which the data are collected. Errors of the first group depend on the degree of permanency of channel and of permanency of the relation between discharge and stage.

Errors of the second class are due, first, to errors in observation of stage; second, to errors in measurements of flow; and, third, to errors due to misinterpretation of stage and flow data.

Practically all discharge measurements made under fair conditions are well within 5 per cent of the true discharge at the time of observation. Inasmuch as the errors of meter measurements are largely compensating, the mean rating curve, when well defined, is much more accurate than the individual measurements. Numerous experi-

[1] See Hoyt, J. C., and others, Use and care of current meter as practiced by the U. S. Geol. Survey: Trans. Am. Soc. Civil Eng., vol. 66, 1910, p. 70.

ments made to test the accuracy of current-meter work show that it compares very favorably with the results from standard weirs, and, owing to simplicity of methods, usually gives results that are much more reliable than those from stations at dams, where the coefficient may be uncertain and conditions of flow are complicated.

The work is, of course, dependent on the reliability of the gage observers. With relatively few exceptions, the observers perform their work honestly. The records are, however, closely watched, and the cause of any discrepancy is investigated. It is obvious that one gage reading a day does not always give the mean height for that day. As an almost invariable rule, however, errors from this source are compensating and virtually negligible in a period of one month, although a single day's reading may, when taken by itself, be considerably in error.

An effort is made to visit every station at least once each year for the purpose of making a measurement to determine the constancy of conditions of flow since the last measurement made in the preceding year, and also to check the elevation of the gage. On account of lack of funds or for other causes some stations were not visited during the current year. If conditions of flow have been reasonably permanent up to the time of the last preceding measurements, it is considered best to publish estimates of discharge based on the latest verified rating curve rather than to omit them altogether, although it should be distinctly understood that such records are at times subject to considerable error. This is also true, although to a less degree, of the period of records since the date of the last measurement of the current year. As a rule, the accuracy notes are based on the assumption that the rating curve used is strictly applicable to the current year.

In order to give engineers and others information regarding the probable accuracy of the computed results, footnotes are added to the daily discharge tables, stating the probable accuracy of the rating tables used, and an accuracy column is inserted in the monthly discharge table. For the rating tables "well defined" indicates, in general, that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined" or "approximate," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The accuracy column in the monthly discharge table does not apply to the maximum or minimum nor to any individual day, but to the monthly mean. It is based on the accuracy of the rating, the probable reliability of the observer, and knowledge of local conditions. In this column A indicates that the mean monthly flow is probably accurate within 5 per cent; B, within 10 per cent; C, within 15 per

cent; D, within 25 per cent. Special conditions are covered by footnotes.

In general, the base data which are collected in the field each year by the Survey engineers are published, not only to comply with the law but also for the express purpose of giving to any engineer the opportunity of examining the computed results and of changing and adjusting them as may seem best to him. Although it is believed that the rating tables are computed monthly, discharges are as good as the base data up to and including the current year will warrant, it should always be borne in mind that the additional data collected at each station from year to year nearly always throw new light on data already collected and published, and hence allow more or less improvement in the computed results of earlier years. It is therefore expected that the engineer who makes serious use of the figures presented in these papers will verify all ratings and make such adjustments for earlier years as may seem necessary. The work of compiling, studying, revising, and republishing data for different drainage basins for 5 or 10 year periods or more is carried on by the United States Geological Survey so far as the funds for such work are available.

The estimates in the table of monthly discharge are so arranged as to give only a general idea of the conditions of flow at the station, and it is not expected that they will be used for other than preliminary estimates.

The daily discharges are published to allow a more detailed study of the variation in flow and to determine the periods of deficient flow.

COOPERATIVE DATA.

Cooperative data of various kinds and data regarding the run-off at many stations maintained wholly by private funds are incorporated in the surface water-supply reports of the United States Geological Survey.

Many stations throughout the country are maintained for specific purposes by private parties who supply the records gratuitously to the United States Geological Survey for publication. When such records are furnished by responsible parties and appear to be reasonably accurate, they are verified, so far as possible, and estimated values of accuracy are given. Records clearly worthless or misleading are not published. As it is, however, impossible to completely verify all such records furnished—because of lack of funds or for other causes—they are published for what they are worth, as they are of value as a matter of record and afford at least approximate information regarding stream flow at the particular localities. The Survey does not, however, assume any responsibility for inaccuracies found in such records, although most of them are believed to be reasonably good.

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COOPERATION AND ACKNOWLEDGMENTS.

MINNESOTA.

The work in Minnesota during 1910 has been carried on in conjunction with the State Drainage Commission, George A. Ralph, chief engineer, under the terms of an act of the legislature of 1909, as embodied in joint resolution 19:

> Whereas the water supplies, water powers, navigation of our rivers, drainage of our lands, and the sanitary condition of our streams and their watersheds generally form one great asset and present one great problem: Therefore be it
>
> *Resolved by the House of Representatives (the Senate concurring)*, That the State Drainage Commission be and is hereby directed to investigate progress in other States toward the solution of said problem in such States, to investigate and determine the nature of said problem in this State. * * *

Special acknowledgment is due to the Great Northern Power Co. for cooperation in maintenance of the gaging station on the St. Louis River near Thomson, Minn., and winter records of discharge of Cloquet River.

MICHIGAN.

Assistance has been rendered or records furnished by the following, to whom special acknowledgment is due: State Geological Survey of Michigan; Penn Iron Mining Co.; Oliver Iron Mining Co.; Mr. L. W. Anderson, city engineer, Grand Rapids, Mich.; the Eastern Michigan Edison Co., Ann Arbor, Mich.; Mr. D. W. Mead, Madison, Wis.; Mr. Gardner S. Williams, Ann Arbor, Mich.; and Mr. William G. Fargo, Jackson, Mich.

NEW YORK.

Assistance has been rendered or records furnished by the following, to whom special acknowledgment is due: United States Engineer Corps; Hon. Frank M. Williams, State engineer and surveyor, William B. Landreth, special deputy State engineer, representing New York State cooperation; State Water-Supply Commission of New York, Hon. Henry M. Persons, president; E. A. Fisher, city engineer, and board of park commissioners, Rochester; George Beebe, chief engineer and superintendent bureau of water, Syracuse; Plattsburg Gas & Electric Co., Plattsburg.

New York State cooperation, under the direction of the State engineer and surveyor, has been carried on by cooperative agreements authorized by an act of the State legislature, being paragraph 11 of chapter 420, laws of 1900.

Cooperation with the State water-supply commission was made possible by the provisions of the "Fuller bill," chapter 569, laws of 1907, and carried on under agreements between the State water-supply commission and the United States Geological Survey.

VERMONT.

The work in Vermont during 1910 has been done in cooperation with the State of Vermont, George H. Prouty, governor, under the provisions of the following act of the general assembly:

AN ACT To provide for investigation of the water resources of the State of Vermont and to make the records of such investigation available to the authorities of the State, and to all the people thereof.

It is hereby enacted by the General Assembly of the State of Vermont:

SECTION 1. That, as the Director of the United States Geological Survey is authorized to cooperate with the properly constituted authorities in the several States in making investigation of and reports upon the water resources of these States, the governor of the State of Vermont is hereby empowered to enter into contract with the Director of the United States Geological Survey for the purpose of making such investigation and report for this State, provided that such work shall include, first, the completion of the surveys of river basins already partially investigated; and provided further, that the director shall agree to expend for this purpose, and from funds placed at his disposal by the Government of the United States, sums equal to those hereinafter appropriated.

SEC. 2. That, for the purpose set forth in section 1 of this act, the sum of $1,000 for the year 1909, and a like sum for the year 1910, is hereby appropriated to be expended by the State, in accordance with the laws relating to, and the regulations of, the United States Geological Survey in such case provided, payment to be made on vouchers audited and approved by the director of said survey, when presented to the auditor of accounts.

Assistance has been rendered or records furnished by the following, to whom special acknowledgment is due: Newport Electric Light Co.; Prof. C. S. Carleton, of Norwich University; Lane Manufacturing Co.; Morrisville water and light commissioners; Colton Manufacturing Co.; Corry, Deavitt & Frost Electric Co.; Sweat-Comings Manufacturing Co.

DIVISION OF WORK.

The field data in the Lake Superior drainage basin were collected under the direction of Robert Follansbee, district engineer, assisted by G. A. Gray and C. R. Adams.

The field data in the Lake Michigan, Lake Huron, and Lake Erie drainage basins were collected under the direction of A. H. Horton, district engineer, by private parties.

The field data for New York were collected under the direction of C. C. Covert, district engineer, assisted by W. G. Hoyt and F. J. Shuttleworth.

The field data in the St. Lawrence River drainage basin in Vermont prior to August 1, 1910, were collected under the direction of T. W. Norcross by D. M. Wood, G. M. Brett, and A. D. Butterfield. After August 1, 1910, the work in Vermont was under the direction of C. C. Covert.

The ratings, special estimates, and studies of the completed data were made by A. H. Horton, C. C. Covert, R. H. Bolster, and J. G.

Mathers. The computations and the preparation of the data for publication were made under the direction of R. H. Bolster, assistant engineer, by W. G. Hoyt, J. G. Mathers, F. J. Shuttleworth, Alexander McMillan, and M. I. Walters.

The entire manuscript has been edited by Mrs. B. D. Wood.

GENERAL FEATURES OF THE ST. LAWRENCE RIVER BASIN.[1]

The surface waters of an area 565,000 square miles [2] in extent pass to the ocean by way of St. Lawrence River. In form this area is an irregular parallelogram extending southwestward for about 900 miles with a fairly uniform breadth of 250 miles. The Great Lakes, into which the river expands, have a water surface of 95,600 square miles, leaving for the land surface drained by the river about 470,000 square miles. More than eight-tenths of this area belongs to Canada. The remainder constitutes a part of the United States. With the exception of about 50,000 square miles (including the whole of the Gaspe Peninsula) in the eastern part of the Province, the Canadian portion lies wholly on the north side of the river. The only part of the United States lying north of the river is at the west end of Lake Superior.

At its mouth the river and its tributaries are drowned, so that the salt water of the ocean enters to form the broad bay of St. Lawrence, with its irregular margin, and even beyond the bay there is indication of a river valley carved in the continental shelf completely covered by the ocean waters. Upstream from the bay of St. Lawrence the water area narrows and the water freshens, though the tide rises nearly as far as Montreal, where the St. Lawrence is a very broad river with gentle current. Just above Montreal the river becomes a series of violent rapids, and from this point upstream it consists of stretches of quiet water separated by rapids. At the outlet of Lake Ontario the river passes through a maze of islands beyond which is Lake Ontario—the lowest of the five Great Lakes.

The lakes are connected by broad rivers and straits, which in places are navigable, are elsewhere interrupted by rapids, and in one place are broken by one of the great falls of the world—Niagara. To the entire area above the mouth of Lake Ontario no large river is tributary. In places the divide runs close to the lakes and it is nowhere far from them.

The water surface of Lake Superior nearly equals the combined areas of New Hampshire, Vermont, Massachusetts, and Connecticut; the combined area of the lakes exceeds the area of England, Wales, and Scotland; the length of shore line of the lakes and their connecting

[1] Abstracted from Tarr, R. S., Physical geography of New York State, Macmillan Co., 1902, pp. 220-223.

[2] Ann. Rept. Geol. and Nat. Hist. Survey Canada, new ser., vol. 3, pt. 1, 1887-88, p. 18 B.

rivers is about 5,400 miles, or about equal to the coast line from Maine to the Isthmus of Panama, exclusive of minor indentations.

Lake Superior is 602 feet above sea level and Huron and Michigan are 581 feet above, the intervening descent being made chiefly in the rapids of St. Marys River. From Lake Michigan to Lake Erie (altitude, 573 feet) there is a descent of about 8 feet, mostly in Detroit River. Of the descent from Lake Erie to Lake Ontario (246 feet above sea level), 160 feet occurs at the Falls, 110 feet in the rapids of the gorge, 50 feet in the rapids just above the falls, and 6 feet in the upper Niagara above the rapids.

The beds of all the lakes except Erie are below sea level and the area below this level is so large that even if the water surface was lowered to the level of the sea large bodies of water would remain on the sites of Ontario, Michigan, and Superior; Huron would be greatly reduced in size and Erie would disappear.

The rainfall of the lake area averages about 31 inches, being higher in the eastern than in the northwestern end. This rainfall fills the lakes, satisfies percolation and evaporation, and furnishes for discharge 70,000 cubic feet per second from Lake Superior, 208,000 cubic feet per second from Lake Erie through the Niagara, and 250,000 cubic feet per second from Lake Ontario through the St. Lawrence. Nearly one-half of the total bulk of water in the system is in Lake Superior.

The area tributary to Lake Superior in the United States comprises the northeastern part of Minnesota, a small strip in northern Wisconsin, and nearly one-half of the Northern Peninsula of Michigan. Except at the west end the slopes to the lake are very narrow and are drained by short streams of sharp descent. St. Louis River, which enters at the head of the lake, is the largest and most important stream.

Lake Michigan receives the drainage from a comparatively narrow strip of flat or gently rolling land in the northwestern part of Indiana and the northeastern part of Illinois on the south shore of the lake and the eastern part of Wisconsin and the eastern part of the Northern Peninsula of Michigan on the western and northern shores; on the eastern shore there is a wide strip of the western part of the Southern Peninsula of Michigan. The principal streams entering the lake from the west are Escanaba, Menominee, Peshtigo, Oconto, and Fox rivers; from the east St. Joseph, Kalamazoo, Grand, Muskegon, and Manistee rivers.

The area tributary to Lake Huron in the United States comprises the eastern part of the Southern Peninsula of Michigan. South of Saginaw Bay the Lake Huron slope is very narrow and the brooks and runnels by which it is drained are only a few miles in length.

The so-called Thumb of the Mitten is drained chiefly by three short northward-flowing streams, known as Willow, Pinnepog, and Pigeon rivers, which lie in a flat, marshy region. The Saginaw River system is tributary to the bay at its head, while northward from the bay are Rifle, Au Sable, and Thunder Bay rivers, streams having considerable fall, excellent ground storage, and well-sustained flow. Cheboygan River also belongs in the Lake Huron drainage basin.

That portion of the Lake Erie drainage basin that lies within the United States, exclusive of Lakes Superior, Michigan, and Huron, covers the northern third of Ohio, a small corner of northeastern Indiana, and a similar area in southeastern Michigan. South of the lake the drainage area is narrow, the divide lying in places scarcely 50 miles back from the lake shore. To the west the width of the area is greater, and the Maumee, which enters the lake near Toledo, is the largest stream of northern Ohio. The average altitude of the basin above Lake Erie is 500 feet, but the head of the Maumee at Fort Wayne, Ind., is only 170 feet above the lake. The surface is level or gently rolling.

The principal streams are Huron and Raisin rivers, which enter the lake from the Michigan corner, and Maumee, Black, and Cuyahoga rivers, which enter from Ohio. Of these, the Maumee, formed by the junction of St. Marys and St. Joseph rivers at Fort Wayne, Ind., is the most important.

In the northwestern part of the State of New York, between Niagara and St. Lawrence rivers, is an area aggregating 12,400 square miles drained by streams which flow into Lake Ontario. The divide which controls this drainage is very irregular. Extending to the south and southeast from Fort Niagara, it passes around the headwaters of the Genesee a short distance into Pennsylvania; thence reentering New York it runs southward and eastward from the interior group of lakes, turns to the north, encircles the sources of Black River, turns again to the west, and descends to the lake. The country thus included is level or gently undulating in the counties bordering the lake, but farther south it becomes more rolling, and a series of ridges, gradually increasing in height, stretch down between Cayuga and Seneca and their companion lakes, finally becoming merged with the elevated, broken country forming the principal divide whose abrupt slopes reach altitudes of 2,000 to 2,500 feet about the headwaters of the Genesee.

The easterly or Black River lobe of the drainage basin receives the run-off from the southwestern slope of the Adirondack Mountains—largely a rugged and forest-covered area receiving heavy precipitation, especially in the winter.

The principal streams of the area are Genesee, Oswego (formed by the union of Seneca and Oneida rivers, which drain the chain of lakes in central New York), Salmon, and Black rivers.

St. Lawrence River receives also the flow of a number of New York streams rising on the northerly slopes of the Adirondacks and fed by the innumerable lakes with which the region is dotted. Some of these rivers, as the Grass, Raquette, and St. Regis, lie entirely within the United States; others, notably Salmon, Trout, Chateaugay, and English rivers, cross the international boundary and flow northward into the St. Lawrence in Canada, as does also Richelieu River, the outlet of Lake Champlain. The following table gives a list of the principal tributaries of the St. Lawrence in the United States, with the areas drained by them:

Drainage areas of St. Lawrence River tributaries in the United States.

	Square miles.		Square miles.
Oswegatchie River	1,609	Salmon River[1]	273
Grass River	637	Trout River[2]	129
Raquette River	1,219	Chateaugay River[2]	199
St. Regis River	910	English River[2]	53
Little Salmon River[1]	103	Lake Champlain[2]	8,187

The St. Lawrence drains, through Lake Champlain, an area of about 4,560 square miles in the State of Vermont. This drainage is practically all from Missisquoi, Lamoille, and Winooski rivers and Otter Creek. Clyde, Barton, and Black rivers, in northern Vermont, are tributary to St. Lawrence River through Lake Memphremagog and St. Francis River.

BASINS TRIBUTARY TO LAKE SUPERIOR.

ST. LOUIS RIVER BASIN.

GENERAL FEATURES.

St. Louis River drains an area in the northeastern part of Minnesota, chiefly in southern St. Louis County. The river rises in a small lake on the extreme western edge of Lake County, Minn., in T. 59 N., R. 11 W. It flows southwestward through Seven Beaver Lake, then southward until it reaches a point about 6 miles above the St. Louis-Carlton County line, whence its general course is northeastward to the extreme western end of Lake Superior. Its principal tributaries are Partridge, Embarrass, and Floodwood rivers from the west and Whiteface and Cloquet rivers from the east.

From the crossing of the Duluth & Iron Range Railroad near Skibo to a point nearly at the mouth of Whiteface River, the St. Louis flows between banks ranging in height from 10 to 30 feet and its valley is little wider than the river itself. In the 10 miles below the Whiteface the banks are 15 to 20 feet high, but below that section the valley gradually widens and becomes deeper. At Thompson the

[1] Above junction near international boundary.

[2] Above New York State line.

river enters a deep, narrow gorge, in which it continues nearly to Lake Superior, and falls nearly 500 feet.

The following drainage areas have been measured in the basin:

Drainage areas in St. Louis River basin.

River.	Drainage area above—	Square miles.
St. Louis	Seven Beaver Lake	46
Do	Sec. 4, T. 57 N., R. 14 W	84
Do	Sec. 22, T. 58 N., R. 15 W	109
Do	Sec. 29, T. 58 N., R. 15 W	299
Do	Embarrass River	332
Do	Sec. 2, T. 56 N., R. 17 W	500
Do	Sec. 29, T. 56 N., R. 18 W	881
Do	Whiteface River	1,280
Do	Cloquet River	2,440
Do	Sec. 22, T. 50 N., R. 17 W	3,170
Do	Mouth	3,440
Embarrass	....do	165
Whiteface	Meadowlands	442
Do	Mouth	522
Floodwood	....do	224
Cloquet	Sec. 20, T. 54 N., R. 13 W	313
Do	Alden Lake outlet	395
Do	Sec. 34, T. 53 N., R. 14 W	438
Do	Sec. 15, T. 52 N., R. 15 W	523
Do	Independence	698
Do	Mouth	742

The area is covered with a thin layer of sand, clay, and gravel. In the upper portion of the basin this drift sheet rests on crystalline rocks of Cambrian age. The lower valley exhibits the oldest rocks in the region—slates and other rocks of Archean age—but such outcrops are not numerous, for the river has cut through the drift sheet in but few places.

The northern boundary of the basin is, in general, the line of hills rising from 300 to 500 feet above the plain and known as the Mesabi Range. Through a break in the hills Embarrass River flows, draining a considerable area north of the range. The greater part of the area above the mouth of Cloquet River is a vast swamp, containing much muskeag, through which the flow of the river is greatly obstructed. The eastern part of the basin is rougher than the western, although it contains areas of muskeag.

Much of the area is densely forested, although it has been burned and cut over extensively, but within the densely timbered areas are other areas where the cover is thin. The trees found in greatest abundance are white, Norway, and jack pine, spruce, balsam, tamarack, and cedar.

The mean annual rainfall ranges from 28 inches in the western to about 31 inches in the eastern part of the basin, 5 inches or more occurring as snow, which remains during the winter months. As winter thaws are unknown, the winter flow of the streams is derived from the few lakes which exist in the area and from ground water.

Logging dams have been erected at the following points for the purpose of storing the waters for log driving during the spring and summer months:

St. Louis River	Sec. 4, T. 57 N., R. 14 W.
Embarrass River	Sec. 6, T. 58 N., R. 15 W.
Partridge River	Sec. 6, T. 58 N., R. 14 W.
Paleface River	Sec. 36, T. 56 N., R. 16 W.
Whiteface River	Sec. 2, T. 54 N., R. 16 W.
Bug Creek	Sec. 21, T. 54 N., R. 16 W.
Ushkabwakka River	Sec. 14, T. 52 N., R. 16 W.
Cloquet River	Sec. 19, T. 53 N., R. 13 W. and Sec. 15, T. 52 N., R. 15 W.
Beaver River	(Which drains Wild Rice Lake.)
West Branch of Cloquet River	Sec. 15, T. 55 N., R. 13 W.
Branch of Cloquet River	Sec. 12, T. 55 N., R. 13 W.
Little Cloquet River	Sec. 18, T. 54 N., R. 12 W. Sec. 25, T. 54 N., R. 13 W., and Sec. 36, T. 54 N., R. 13 W.
Branch of Cloquet River	Sec. 17, T. 53 N., R. 13 W.

The operation of these dams hinders rather than aids the uniform regulation of the stream flow in the basin, as the dams are closed during the winter, the season of minimum flow, to hold back a large part of the flow until the spring and early summer, when the flow is greater than the average for the year, to drive the logs downstream as far as Cloquet. After the driving is completed the dams are usually left open until the late fall or winter. That it is possible to reconcile these conflicting interests has been proved in Maine, where the lumber and power interests have cooperated to increase the storage facilities and improve the channels and thus lessen the waste incidental to log driving.

The swampy areas of the basin afford a large amount of natural storage. Wild Rice Lake, in T. 51 N., R. 15 W., which is used as a reservoir in connection with the development of power on the lower St. Louis, has an area of 5 square miles with a draft of 5 feet, making its storage capacity 139 million cubic feet. Another storage reservoir has recently been built on Beaver River, which drains Wild Rice Lake.

In order to determine the amount of power available along St. Louis, River, a survey was made during 1910 from Scanlon to the crossing of the Duluth & Iron Range Railroad near Skibo. From the data collected, sheets have been prepared showing a profile of the water surface, a plan of the river, contours along the banks, and prominent natural and artificial features. The results of this survey have been published on separate sheets, which may be obtained by applying to the district engineer, United States Geological Survey, Old Capitol Building, St. Paul, Minn. From this survey the following table of elevations and distances has been compiled:

Distances and elevations along St. Louis River.

Place.	Distance above Scanlon.	Elevation.
	Miles.	*Feet.*
Scanlon River	0	1,101
Cloquet:		
Lower dam, tailwater	2	1,105
Lower dam, headwater	2	1,155
Upper dam, tailwater	3	1,156
Upper dam, headwater	3	1,172
Foot of rapids	9	1,176
Head of rapids	13	1,201
Cloquet River	18	1,206
Congo	27	1,208
Gowan	33	1,216
Floodwood	39	1,225
Whiteface	45	1,226
Elmer	55	1,233
Swan	64	1,241
Casco	72	1,251
Zim Bridge	78	1,261
Great Northern Railway	88	1,292
Forbes	91	1,294
Miller truck road	98	1,308
Otter Creek	104	1,315
Embarrass River	106	1,317
Vermilion Lake road	114	1,330
Aurora bridge	127	1,364
Partridge River	127	1,370
Foot of rapids	130	1,386
Head of rapids	131	1,413
Foot of rapids	132	1,414
Head of rapids, logging dam	135	1,476
Below logging dam	143	1,495
Head of rapids	147	1,544
Duluth & Iron Range Railroad	149	1,562

Water power is developed at two points on the St. Louis. At Cloquet a head of 66 feet is utilized in developing about 7,000 horsepower, and near Thompson a head of 375 feet is utilized in developing an average of 15,000 horsepower.

A survey similar to that of the St. Louis was made in 1910 of Cloquet River from Brimson to the mouth. From this survey the following table of elevations and distances has been compiled:

Distances and elevation along Cloquet River.

Place.	Distance below Brimson.	Elevation.
	Miles.	*Feet.*
Duluth & Iron Range Railroad	0	1,468
West Branch Cloquet River	5	1,459
Foot of rapids	5	1,453
Head of rapids	13	1,438
Foot of rapids	14	1,420
Little Cloquet River	23	1,395
Head of rapids	25	1,394
Foot of rapids	25	1,385
Alden Lake outlet	27	1,383
Below dam, Alden Lake outlet	27	1,377
Vermilion Lake road	31	1,363
Foot of rapids	32	1,354
Head of Big Falls	32	1,353
Foot of Big Falls	33	1,332
Island Lake	34	1,330
High dam, headwater	42	1,330
High dam, tailwater	42	1,319
Duluth & Northeastern Railroad	53	1,312
Foot of rapids	55	1,296
Head of rapids	59	1,289
United States Geological Survey gaging station at Independence	61	1,270
Duluth, Missabe & Northern Railway	66	1,240
St. Louis River	70	1,206

The following table of approximate elevations and distances has been compiled from various sources:

Elevations and distances along Whiteface River.

Place.	Distance above mouth.	Elevation.
	Miles.	*Feet.*
St. Louis River	0	1,226
Sec. 24, T. 52 N., R. 20 W	7	1,232
Meadowlands	18	1,259
Sec. 29, T. 54 N., R. 18 W	26	1,269
Kelsey	30	1,281
Sec. 9, T. 54, N., R. 17 W	36	1,306
Bassett	80	1,610
Jack Pine Lake outlet	86	1,660

The chief industry in this part of the State is logging. Very little land has been cleared and cultivated. Swamps, impassable during the summer months, make much of the area, and little drainage work has been done. About 117,000 acres has been ditched in St. Louis County.

ST. LOUIS RIVER NEAR THOMSON, MINN.

This station, which is located just below the tailrace of the Great Northern power house, 3 miles east of Thomson, in sec. 11, T. 48 N., R. 16 W., was established October 5, 1909, in cooperation with the Great Northern Power Co., which furnishes the daily gage readings.

No important tributary enters within several miles of the station.

The chain gage is located just below the tailwater of the power house, and is read four times daily—at 8 and 11 a. m. and 2 and 5 p. m.—the average of these readings being taken as the mean for the day. As the plant is operated 24 hours each day, though with varying load, the fluctuations at the gage are not so great as they would be if the turbine was closed a part of the time.[1]

The datum of the gage has not been changed since the station was established.

Discharge measurements are made from a car and cable 1,500 feet below the gage.

The records do not indicate the natural flow of the river at all times, as the flow is to a certain extent regulated by reservoirs above. The dam at Thomson is designed to hold 24 hours' supply of water for the power plant, and the discharge from a large part of the entire drainage area above the gaging station is controlled by logging dams. The logging dams in general are closed during the winter months to store the flow, in order to drive logs to Cloquet in the spring, and when the drives are finished the dams are left open until it is time to store water for the next season's drive.

[1] A brief description of this power plant is given in the cooperative report published by the State Drainage Commission, St. Paul, Minn., entitled "Report of water resources investigation of Minnesota during 1909-10."

The discharge at this station has been reported as practically unaffected by ice, but in November, 1910, the stage became extremely low and the water froze, making the gage heights of little value as indications of discharge. During the winter of 1910 no water flowed over the spillway, and the daily discharge was computed from the amount of water passing the turbines, as recorded by the power company.

The station affords excellent conditions for determining flow, and, except for possible errors in the mean gage height for the day, the records should be good.

Discharge measurements of St. Louis River near Thomson, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Oct. 5	Follansbee and Gray	240	1,430	2.56	2,610
Nov. 2	G. A. Gray	250	1,700	3.33	3,960
1910.					
Jan. 12	Gray and King	177	910	.90	[a]709
Apr. 13	Follansbee and Gray	208	1,240	1.88	1,850
June 16	C. R. Adams	190	1,000	.92	921
July 27	G. A. Gray	188	906	.64	613
Sept. 13	C. R. Adams	195	1,050	1.22	1,080

[a] Probably affected by meter freezing.

Daily gage height, in feet, of St. Louis River near Thomson, Minn., for 1910.

[N. Van Valkenburgh, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.30	0.65	0.65	2.80	2.63	2.48	0.16	1.99	1.32	2.01	1.40
2	1.22	.61	.70	2.85	1.82	2.11	.20	1.97	1.24	2.27	.46
3	1.21	.58	.67	3.12	2.08	1.99	.26	2.21	.95	2.30	1.34
4	1.38	.74	.61	3.02	1.66	1.84	.28	2.06	.98	1.90	1.42
5	1.38	.72	.68	3.03	2.62	1.82	.30	2.59	.85	1.95	1.44
6	1.19	.73	.80	3.10	2.15	1.78	.29	2.39	.98	1.83	.61
7	1.11	.72	.88	2.64	1.81	1.65	.32	1.80	.97	1.85	.42
8	1.02	.75	.98	2.70	1.95	1.69	.34	.34	1.24	1.70	.41
9	1.02	.62	.95	2.20	2.02	1.36	.33	1.24	1.45	1.26	.50
10	1.00	.65	.90	2.90	2.03	1.73	.32	.59	1.71	1.01	.38
11	.99	.70	.82	1.28	1.92	1.00	.26	.46	1.81	.97	.....
12	.93	.63	.88	1.80	1.68	.....	.31	.40	1.58	.52	.....
13	.83	.48	.92	1.88	1.60	.42	.32	.36	1.28	.45	.....
14	.62	.72	1.09	1.70	1.30	.85	.30	.32	.....	.45	.....
15	.72	.....	1.16	2.04	1.27	1.26	.32	.31	.....	.47	.....
16	.73	.....	1.30	2.20	1.20	.86	.35	.36	.....	.39	.....
17	.78	.80	1.36	1.96	1.31	.62	.32	.37	.....	.88	.....
18	.78	.75	1.59	1.76	1.15	.65	.34	.31	.....	1.70	.....
19	.82	.64	1.60	2.46	1.04	.43	.30	.35	.....	1.81	.....
20	.92	.63	1.85	3.20	1.21	.26	.44	.40	.44	1.44	.....
21	.89	.74	1.98	3.48	1.53	.54	.42	.36	.36	1.64	.....
22	.82	.70	2.19	3.83	2.17	.38	.35	.36	.39	1.59	.....
23	.80	.68	2.40	3.42	2.06	.36	.38	.85	.40	1.64	.....
24	.81	.75	2.48	3.35	2.10	.35	.45	.94	.35	1.55	.....
25	.99	.80	2.55	3.00	2.66	.39	.95	1.37	.39	1.48	.....
26	.82	.80	2.94	3.33	2.89	.40	1.05	1.47	.35	1.02	.....
27	.76	.75	2.95	2.90	2.59	.05	.68	1.42	.38	1.40	.....
28	.63	.80	2.67	2.82	2.40	.06	.84	1.43	.40	1.46	.....
29	.59	.....	2.54	2.77	2.33	.07	.89	1.35	1.01	1.48	.....
30	.50	.....	2.54	2.63	2.02	.11	1.00	1.42	2.01	1.58	.....
31	.72	.....	2.56	.....	2.32	.....	1.42	1.39	.....	1.48	.....

NOTE.—No flow over dam Nov. 11 to Dec. 31, 1910. Gage observations during this period discontinued because of ice.

Daily discharge, in second-feet, of St. Louis River near Thomson, Minn., for 1909–10.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1909.				1909.				1909.			
1	.....	3,970	3,200	11	1,980	2,120	3,420	21	2,900	2,880	2,100
2	.....	3,780	3,780	12	1,470	1,620	3,150	22	3,430	2,420	1,650
3	.....	3,590	4,250	13	1,400	1,440	2,880	23	3,850	2,120	1,560
4	.....	3,710	4,270	14	1,510	1,880	2,760	24	3,800	1,630	1,810
5	2,540	4,600	4,270	15	2,680	2,170	2,860	25	4,220	2,200	1,740
6	2,070	3,920	4,200	16	2,620	2,960	2,790	26	4,640	2,320	1,650
7	1,640	3,240	3,560	17	2,800	2,330	2,320	27	4,640	3,210	1,720
8	1,920	2,740	3,530	18	3,530	2,100	1,980	28	4,510	3,300	1,790
9	2,340	2,440	2,760	19	2,880	2,370	2,000	29	4,740	2,870	1,520
10	2,300	2,220	3,120	20	3,460	3,030	2,110	30	4,320	3,240	1,700
								31	4,040	.....	1,430

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910.												
1	1,210	645	645	3,030	2,790	2,580	360	1,960	1,230	1,990	1,310	275
2	1,130	617	680	3,100	1,760	2,110	380	1,940	1,150	2,310	521	248
3	1,120	597	659	3,530	2,070	1,960	410	2,230	885	2,340	1,250	293
4	1,290	710	617	3,370	1,590	1,790	420	2,050	912	1,860	1,330	294
5	1,290	695	666	3,380	2,770	1,760	430	2,730	798	1,920	1,350	318
6	1,110	702	755	3,500	2,160	1,720	425	2,460	912	1,770	617	273
7	1,030	695	823	2,800	1,750	1,580	441	1,740	903	1,800	497	238
8	948	718	912	2,880	1,920	1,620	452	452	1,150	1,630	491	269
9	948	624	885	2,220	2,000	1,270	446	1,150	1,360	1,170	545	289
10	930	645	840	3,180	2,010	1,660	441	604	1,640	939	474	259
11	921	680	772	1,190	1,880	930	410	521	1,750	903	319	294
12	867	631	823	1,740	1,610	714	436	485	1,500	558	407	303
13	780	533	858	1,830	1,520	497	441	463	1,190	515	336	300
14	624	695	1,010	1,630	1,210	798	430	441	1,090	515	375	284
15	695	715	1,080	2,020	1,180	1,170	441	436	995	527	316	309
16	702	735	1,210	2,220	1,120	806	458	463	898	480	280	293
17	740	755	1,270	1,930	1,220	624	441	468	800	823	346	274
18	740	718	1,510	1,700	1,070	645	452	436	703	1,630	321	268
19	772	638	1,520	2,560	966	503	430	458	606	1,750	332	310
20	858	631	1,800	3,660	1,120	410	509	485	509	1,350	327	291
21	832	710	1,950	4,140	1,450	571	497	463	463	1,560	360	283
22	772	680	2,210	4,790	2,180	474	458	463	480	1,510	319	301
23	755	666	2,480	4,040	2,050	463	474	798	485	1,560	355	289
24	764	718	2,580	3,920	2,100	458	515	876	458	1,470	322	237
25	921	755	2,680	3,340	2,830	480	885	1,280	480	1,390	348	298
26	772	755	3,240	3,880	3,160	485	975	1,380	458	948	316	268
27	725	718	3,260	3,180	2,730	308	666	1,330	474	1,310	324	290
28	631	755	2,840	3,060	2,480	312	789	1,340	485	1,370	332	273
29	604	.....	2,660	2,990	2,380	316	832	1,260	939	1,390	296	282
30	545	.....	2,660	2,790	2,000	335	930	1,330	1,990	1,500	256	246
31	695	.....	2,690	.....	2,370	.....	1,330	1,300	.....	1,390	.....	278

NOTE.—Daily discharge determined from a discharge rating curve well defined above 500 second-feet. No flow over the dam Nov. 11 to Dec. 31; daily discharge during this period taken directly from the records of flow through the wheels and gate openings, kept by the Great Northern Power Co.

Monthly discharge of St. Louis River near Thomson, Minn., for 1909–10.

[Drainage area, 3,420 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
October 5–31	4,740	1,400	3,050	0.892	0.90	B.
November	4,600	1,440	2,750	.804	.90	B.
December	4,270	1,430	2,640	.772	.89	B.
1910.						
January	1,290	545	862	.252	.29	B.
February	755	533	683	.200	.21	C.
March	3,260	617	1,570	.459	.53	B.
April	4,790	1,190	2,920	.854	.95	B.
May	3,160	966	1,920	.561	.65	B.
June	2,580	308	978	.286	.32	B.
July	1,330	360	549	.161	.19	C.
August	2,730	436	1,090	.319	.37	B.
September	1,750	458	923	.270	.30	B.
October	2,340	480	1,360	.398	.46	B.
November	1,350	256	499	.146	.16	B.
December	318	237	282	.082	.09	B.
The year	4,790	237	1,140	.332	4.52	

WHITEFACE RIVER AT MEADOWLANDS, MINN.

This station, which is located at the highway bridge at Meadowlands, Minn., in sec. 14, T. 53 N., R. 19 W., was established June 7, 1909.

The nearest tributary is a very small stream that enters from the east half a mile above.

The gage is a staff at the bridge.

Discharge measurements at high and ordinary stages are made from the bridge; low-water measurements are made by wading at the rapids nearly 2 miles below the station.

Whiteface River is used extensively for log driving, and the flow is to a large extent controlled by logging dams above the station. The opening and closing of the gates of these dams causes fluctuations in gage height amounting to several feet, and the records of extreme stage are therefore of little value.

The relation of gage height to discharge is affected by backwater from log jams, and the discharge has been determined from a number of discharge rating curves, some of which have been applied indirectly. The records can not be considered better than fair.

Discharge measurements of Whiteface River at Meadowlands, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 7	Hoyt & Gibson	104	661	6.52	708
Aug. 5	G. A. Gray	104	588	5.71	341
Aug. 24[a]	do	104	643	6.09	677
Oct. 3	do	104	470	5.09	309
1910.					
Apr. 21	do	84	659	6.22	656
July 2[a]	do	132	227	4.50	215

[a] Wading measurement.

Daily gage height, in feet, of Whiteface River at Meadowlands, Minn., for 1910.

[A. F. Johnson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	4.85	5.3	5.85	3.8	5.65	3.7	6.4	3.8
2	.....	4.8	4.25	5.4	3.7	4.5	3.8	5.4	3.8
3	.....	4.7	7.15	5.3	3.8	3.5	3.8	7.0	3.8
4	.....	4.65	6.95	5.0	3.8	3.4	3.8	6.5	3.8
5	.....	4.6	4.9	4.8	4.0	3.4	4.0	6.0	3.8
6	.....	4.45	3.9	5.0	4.0	3.4	4.25	6.5	3.8
7	.....	4.3	3.95	5.65	3.8	3.4	4.45	6.0	3.8
8	.....	4.3	3.9	6.35	3.75	3.4	3.95	5.5	3.8
9	.....	4.25	3.9	5.0	3.7	3.4	4.0	4.75	3.7
10	.....	5.85	3.8	4.3	3.65	3.4	4.15	4.2	3.7
11	.....	4.5	3.9	3.95	3.55	3.4	4.2	4.1	.....
12	.....	4.25	3.9	4.4	3.45	3.4	4.1	4.1	.....
13	.....	4.1	5.3	8.05	3.4	3.75	3.8	4.2	.....
14	.....	6.05	3.9	6.3	3.4	4.2	3.8	4.0	.....
15	.....	4.3	4.4	3.85	3.4	4.0	3.8	4.0	.....
16	.....	4.65	3.9	3.55	3.4	4.4	3.7	4.0	.....
17	.....	4.25	3.7	3.6	3.3	4.4	3.65	4.0	.....
18	.....	4.45	3.85	3.45	3.3	4.35	3.5	3.9	.....
19	.....	6.65	3.95	3.4	3.2	4.2	3.5	3.9	.....
20	.....	6.35	4.0	3.4	3.3	4.0	3.4	3.8	.....
21	.....	5.85	5.05	3.4	3.3	3.9	3.4	4.9	.....
22	.....	4.25	5.25	3.4	3.3	3.9	3.4	5.2	.....
23	.....	6.95	5.6	3.4	3.5	3.8	3.3	5.0	.....
24	.....	6.0	8.15	3.4	3.5	3.8	3.4	4.8	.....
25	.....	6.75	8.0	3.65	3.4	3.8	3.5	4.7	.....
26	.....	6.2	7.1	4.35	3.3	3.75	3.7	4.4	.....
27	.....	5.9	6.7	4.20	3.3	3.7	3.9	4.3	.....
28	4.8	4.65	6.75	4.05	3.3	3.7	4.4	4.3	.....
29	4.9	4.55	6.25	4.0	3.7	3.7	4.6	4.3	.....
30	4.8	7.1	6.0	4.0	3.5	3.8	6.0	4.2	.....
31	4.8	.....	6.05	.....	6.65	3.7	.....	4.0	.....

NOTE.—Ice present from Jan. 1 to about Mar. 27 and from Nov. 5 to Dec. 31.

Daily discharge, in second-feet, of Whiteface River at Meadowlands, Minn., for 1909–10.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov
1909.							1909.						
1		40	1,130	510	355	440	16	120	95	2,580	260	510	350
2		35	960	470	315	395	17	120	60	2,450	205	505	350
3		35	870	365	305	260	18	760	220	2,250	190	465	250
4		35	575	390	570	350	19	80	585	1,990	190	530	290
5		35	325	320	250	470	20	50	140	1,190	365	420	365
6		30	375	220	255	385	21	50	635	1,040	475	400	345
7	570	30	210	190	225	385	22	45	2,480	950	720	570	365
8	480	30	220	170	215	295	23	690	2,520	950	1,130	610	345
9	310	30	430	165	220	465	24	280	2,710	635	800	600	405
10	345	30	750	165	245	250	25	335	2,520	550	605	675	470
11	305	40	3,400	160	225	225	26	135	2,250	520	670	645	440
12	120	50	2,820	150	370	225	27	95	1,800	515	750	645	450
13	165	90	2,400	180	395	240	28	75	1,200	460	680	690	505
14	570	90	2,580	275	480	345	29	50	1,300	550	610	550	440
15	120	95	2,930	360	495	385	30	45	800	645	480	430	470
							31		1,310	645		405	

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1910.									
1		285	390	545	115	485	105	730	115
2		275	178	415	105	215	115	415	115
3		255	1,000	390	115	85	115	940	115
4		245	922	315	115	75	115	765	115
5		235	295	275	140	75	140	590	115
6		208	125	315	140	75	178	765	115
7		185	132	485	115	75	208	590	115
8		185	125	712	110	75	132	440	115
9		178	125	315	105	75	140	265	105
10		545	115	185	100	75	162	170	105
11		215	125	132	90	75	170	155	
12		178	125	200	80	75	155	155	
13		155	390	1,300	75	110	115	170	
14		608	125	695	75	170	115	140	
15		185	200	120	75	140	115	140	
16		245	125	90	75	200	105	140	
17		178	105	95	65	200	100	140	
18		208	120	80	65	192	85	125	
19		818	132	75	55	170	85	125	
20		712	140	75	65	140	75	115	
21		545	328	75	65	125	75	295	
22		178	378	75	65	125	75	365	
23		922	470	75	85	115	65	315	
24		590	1,350	75	85	115	75	275	
25		852	1,290	100	75	115	85	255	
26		660	980	192	65	110	105	200	
27		560	835	170	65	105	125	185	
28	275	245	852	148	65	105	200	185	
29	295	225	678	140	105	105	235	185	
30	275	980	590	140	85	115	590	170	
31	275		608		818	105		140	

NOTE.—Daily discharge for 1909 determined by indirect method for shifting channels. Daily discharge for 1910 determined from a fairly well defined discharge rating curve.

Monthly discharge of Whiteface River at Meadowlands, Minn., for 1909–10.

[Drainage area, 442 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
June 7–30	760	45	246	0.557	0.50	C.
July	2,710	30	688	1.56	1.80	C.
August	3,400	150	1,230	2.78	3.20	C.
September	1,130	150	409	.925	1.03	C.
October	690	220	439	.993	1.14	C.
November	505	225	365	.826	.92	C.
1910.						
April	980	155	395	.894	1.00	C.
May	1,350	105	431	.975	1.12	C.
June	1,300	75	267	.604	.67	C.
July	818	55	112	.253	.29	C.
August	485	75	130	.294	.34	C.
September	590	65	139	.314	.35	C.
October	940	115	311	.704	.81	C.
November 1–10			113	.256	.10	C.

CLOQUET RIVER AT INDEPENDENCE, MINN.

This station, which is located at the highway bridge at Independence, in sec. 26, T. 52 N., R. 17 W., was established June 28, 1909.

The nearest tributary is a small stream that enters from the north just above the station.

Cloquet River is used extensively for log driving, and the run-off from by far the greater part of the drainage area above Independence is controlled by logging dams. The opening and shutting of the gates at these dams cause violent fluctuations in the gage height during the day, amounting at times to several feet, and consequently the mean daily gage height, which is the mean of readings taken morning, noon, and night, can be considered only approximate during the log-driving season. The daily discharge data as a whole have little value, the chief purpose of the records being to show the approximate mean monthly discharge and total volume available for storage.

Backwater at the gage may also be caused by log jams forming below the station, but as jams may form at any point along the stream it is impossible to select a more satisfactory site.

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Observations are discontinued from November to April because of ice. The mean monthly flow during this period is estimated from records of flow at Island Lake logging dam above Independence and records of the discharge from Wild Rice Lake on Beaver River, which enters Cloquet River between Island Lake dam and the station. Only one other stream, and that is relatively unimportant, enters above the station. These records are kept by the Great Northern Power Co. and furnished through its courtesy.

The records can not be considered better than fair, or possibly during certain seasons good.

Discharge measurements of Cloquet River at Independence, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 28	G. A. Gray	168	566	6.78	1,720
July 15	Robert Follansbee	122	156	4.01	94.8
Aug. 6	G. A. Gray	164	445	5.90	840
23	do	168	565	6.61	1,440
Oct. 4	do	167	553	6.50	1,430
1910.					
July 28[a]	G. A. Gray	102	217	4.88	316

[a] Wading section.

Daily gage height, in feet, of Cloquet River at Independence, Minn., for 1909.

[Fred Haakensen, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.1	6.5	6.1	6.0	6.9	6.0	16	.....	4.25	7.9	4.5	6.8	5.0	8.4
2	.....	4.0	6.4	4.95	.....	6.15	6.3	17	.....	4.2	7.8	4.45	7.2	5.8	8.3
3	.....	4.0	7.4	4.55	.....	6.9	6.2	18	.....	4.25	7.6	4.4	7.6	5.55	8.4
4	.....	4.0	7.3	5.1	6.4	7.9	5.35	19	.....	6.6	8.0	4.5	7.4	5.6	9.2
5	.....	4.0	7.8	4.7	5.55	7.5	5.3	20	.....	6.8	7.3	4.5	6.5	5.15	8.7
6	.....	3.95	5.85	4.5	5.1	6.8	6.45	21	.....	7.4	7.3	4.95	6.35	5.05	8.4
7	.....	3.95	4.75	4.4	5.4	6.45	7.3	22	.....	8.6	7.5	5.6	6.6	5.15	8.9
8	.....	3.9	7.1	4.3	6.1	6.1	6.7	23	.....	8.8	6.9	6.35	6.3	5.25	9.2
9	.....	3.9	5.15	4.25	5.6	5.85	6.9	24	.....	8.3	6.25	7.4	6.8	5.3	9.2
10	.....	3.9	4.75	4.25	5.3	5.85	7.0	25	.....	8.5	4.85	8.3	6.7	5.6	8.9
11	.....	3.9	6.6	4.2	5.0	5.1	7.8	26	.....	9.1	6.5	7.8	7.2	5.9	.....
12	.....	3.95	6.9	4.25	4.95	4.8	7.7	27	.....	9.1	6.1	7.7	7.4	5.85	.....
13	.....	4.0	7.5	4.35	6.0	4.7	7.7	28	6.7	8.1	6.9	7.2	7.9	5.3	.....
14	.....	4.1	8.2	4.45	5.95	4.75	8.6	29	6.2	6.1	6.9	7.0	7.8	5.3	.....
15	.....	4.1	8.0	4.45	7.2	4.85	8.7	30	5.5	6.6	6.8	6.2	7.9	5.5	.....
								31	.....	6.6	6.45	.....	7.4	.....	.....

NOTE.—Gage heights for 1909 supersede those published in Water-Supply Paper 264. It was necessary to apply a correction to all gage heights below 5 feet because of an error in setting low-water section of the gage.

Daily gage height, in feet, of Cloquet River at Independence, Minn., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	7.04	5.72	5.13	4.62	4.38	5.53	.....	4.87
2	.....	7.83	6.32	4.91	4.65	5.48	5.19	4.42	4.87
3	.....	7.82	5.37	6.13	4.77	5.92	5.12	4.22	4.76
4	.....	7.76	6.96	5.64	4.79	7.11	4.71	4.27	4.37
5	.....	7.60	6.09	6.28	4.68	6.95	6.57	4.10	4.12
6	.....	6.82	5.88	6.37	4.70	4.95	7.42	4.07	4.19
7	.....	6.79	5.54	6.38	4.70	5.25	6.84	4.05	3.94
8	.....	5.58	5.82	5.65	4.77	5.19	5.01	3.94	3.92
9	.....	7.49	6.33	5.36	4.72	4.60	6.83	3.99	3.94
10	.....	5.55	5.72	5.07	4.74	4.22	6.51	3.96	3.98
11	.....	5.30	5.32	5.07	4.75	4.26	5.94	3.95	3.89
12	.....	5.07	4.83	5.04	5.00	4.20	5.54	3.94	3.87
13	.....	5.07	4.70	5.02	4.99	4.32	5.36	3.92	3.82
14	.....	5.01	4.73	4.80	5.02	4.46	5.12	3.94	3.85
15	.....	5.04	5.58	4.65	4.84	4.38	4.90	3.95	3.85
16	.....	5.16	5.30	4.68	4.58	4.30	4.77	3.95	.....
17	.....	5.24	5.06	4.83	4.60	4.26	4.72	4.81	.....
18	.....	5.24	4.76	4.83	4.70	4.32	4.61	7.90	.....
19	.....	5.32	4.71	4.62	4.52	4.62	4.50	7.19	.....
20	.....	6.76	5.38	4.66	4.44	4.98	4.45	5.80	.....
21	.....	7.58	5.66	4.86	4.40	4.86	4.42	5.37	.....
22	.....	7.18	5.43	4.76	4.40	5.91	4.41	5.19	.....
23	.....	7.53	5.61	4.68	4.50	5.51	4.42	4.93	.....
24	.....	6.62	6.31	4.59	6.78	5.87	4.42	4.78	.....
25	7.10	6.63	6.04	4.78	5.06	5.97	4.38	4.89	.....
26	7.35	6.07	6.04	5.03	4.72	5.74	4.50	5.33	.....
27	5.78	5.92	6.06	4.78	4.92	4.93	4.81	4.93	.....
28	5.96	5.68	5.21	4.57	4.98	5.74	5.21	4.89	.....
29	6.00	6.39	5.01	4.51	4.56	5.52	4.92	4.89	.....
30	6.35	5.92	5.24	4.58	4.47	5.24	4.80	4.85	.....
31	6.68	.....	5.30	.....	4.39	5.78	.....	4.85	.....

NOTE.—Ice present from Jan. 1 to Mar. 24 and from Nov. 16 to Dec. 31.

Daily discharge, in second-feet, of Cloquet River at Independence, Minn., for 1909–10.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1909.							1909.						
1	.....	103	1,370	1,000	920	1,850	16	.....	128	3,270	185	1,720	350
2	.....	90	1,270	331	1,040	1,040	17	.....	119	3,120	172	2,250	775
3	.....	90	2,530	199	1,150	1,850	18	.....	128	2,820	160	2,820	622
4	.....	90	2,390	392	1,270	3,270	19	.....	1,480	3,430	185	2,530	650
5	.....	90	3,120	244	622	2,670	20	.....	1,720	2,390	185	1,370	416
6	.....	85	810	185	392	1,720	21	.....	2,530	2,390	331	1,220	371
7	.....	85	260	160	540	1,320	22	.....	4,390	2,670	650	1,480	416
8	.....	80	2,110	138	1,000	1,000	23	.....	4,710	1,850	1,220	1,180	465
9	.....	80	416	128	650	810	24	.....	3,910	1,130	2,530	1,720	490
10	.....	80	260	128	490	810	25	.....	4,230	294	3,910	1,600	650
11	.....	80	1,480	119	350	392	26	.....	5,190	1,370	3,120	2,250	845
12	.....	85	1,850	128	331	277	27	.....	5,190	1,000	2,970	2,530	810
13	.....	90	2,670	149	920	244	28	1,600	3,590	1,850	2,250	3,270	490
14	.....	103	3,750	172	882	260	29	1,080	1,000	1,850	1,980	3,120	490
15	.....	103	3,430	172	2,250	294	30	595	1,480	1,720	1,080	3,270	595
							31	.....	1,480	1,320	.....	2,530	.....

Daily discharge, in second-feet, of Cloquet River at Independence, Minn., for 1909–10—Con.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1910.									
1		2,030	723	406	219	156	612	216	302
2		3,160	1,190	316	228	584	435	165	302
3		3,150	525	1,030	267	860	402	123	264
4		3,060	1,930	674	274	2,120	247	133	153
5		2,820	992	1,160	238	1,920	1,450	103	106
6		1,750	831	1,240	244	331	2,560	99	117
7		1,710	617	1,250	244	465	1,770	96	84
8		639	789	680	267	435	354	84	82
9		2,660	1,200	520	251	213	1,760	89	84
10		622	723	379	257	123	1,380	86	88
11		490	500	379	260	130	875	85	79
12		379	288	367	350	119	617	84	78
13		379	244	358	346	142	520	82	73
14		354	254	277	358	175	402	84	76
15		367	639	228	291	156	312	85	76
16		421	490	238	207	138	267	85	70
17		460	375	288	213	130	251	280	70
18		460	264	288	244	142	216	3,270	70
19		500	247	219	191	219	185	2,240	70
20		1,670	530	232	170	342	172	775	70
21		2,780	686	298	160	298	165	525	70
22		2,220	556	264	160	852	162	435	70
23		2,710	656	238	185	600	165	323	70
24		1,500	1,180	210	1,700	824	165	270	70
25	2,110	1,520	952	270	375	898	156	308	70
26	2,460	976	952	363	251	736	185	505	70
27	762	860	968	270	320	323	280	323	70
28	890	698	445	205	342	736	445	308	70
29	920	1,260	354	188	202	606	320	308	70
30	1,220	860	460	207	178	460	277	294	70
31	1,580	.....	490	.....	158	762	.....	294	.....

NOTE.—Discharges during 1909–1910, except those for period Nov. 16–30, 1910, which were estimated, are based on a rating curve well defined below 2,000 second-feet but somewhat uncertain above.

Monthly discharge of Cloquet River at Independence, Minn., for 1909–10.

[Drainage area, 698 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
January	.....	.....	[a] 160	0.229	0.26	C.
February	.....	.....	[a] 195	.279	.29	C.
March	.....	.....	[a] 275	.394	.45	C.
July	5,190	80	1,370	1.96	2.26	B.
August	3,750	260	1,940	2.78	3.20	B.
September	3,910	119	819	1.17	1.30	B.
October	3,270	331	1,540	2.21	2.55	B.
November	3,270	260	875	1.25	1.40	B.
December	.....	.....	[a] 840	1.20	1.61	C.
1910.						
January	.....	.....	[b] 220	.315	.36	C.
February	.....	.....	[b] 300	.430	.45	C.
March	2,460	.....	[b] 370	.530	.57	C.
April	3,160	354	1,420	2.03	2.26	B.
May	1,930	244	679	.973	1.12	B.
June	1,250	188	435	.623	.70	B.
July	1,700	158	295	.423	.49	B.
August	2,120	119	516	.739	.85	B.
September	2,560	156	570	.817	.91	B.
October	3,270	82	392	.562	.65	B.
November	.....	.....	100	.143	.16	B.
December	.....	.....	[b] 80	.115	.13	C.
The year	3,270	.....	444	.636	8.61	

[a] Estimated by means of climatologic records and comparison with flow of St. Louis River.
[b] Estimated from records of Great Northern Power Co.

BASINS TRIBUTARY TO LAKE MICHIGAN.

ESCANABA RIVER BASIN.

GENERAL FEATURES.

Escanaba River rises in the western part of Marquette County, near Lake Michigamme, and takes a general southeasterly course to Little Bay de Noquette, an arm of Lake Michigan, which it enters near Escanaba, Mich. Its length is about 90 miles and its drainage area, which lies in the central part of the Northern Peninsula of Michigan, comprises about 890 square miles.

The basin is long and narrow and comparatively regular in outline, the average width of its lower half being less than 10 miles, its extreme width about 25 miles, and its length about 70 miles. In its upper course the river flows through an area of crystalline rocks, but farther down the rocks are sandstones and limestones. The headwaters of the river have an elevation of about 1,600 feet above sea level, and at its mouth the elevation is 580 feet, making a total descent of about 1,000 feet, or an average fall of over 10 feet to the mile.

The tributaries of the river are small, the West Branch being the only one of importance.

The mean annual rainfall in this part of Michigan is about 32 inches. The winters are severe; the snowfall is heavy and lasts for considerable periods, and ice covers the streams to a thickness of about 2 feet for three to four months.

Lumbering is yet an active industry in this basin, although the greater part of the best timber has been cut off and the river is still used extensively for logging. The change in the forest conditions has probably not affected the run-off of the stream.

Storage sites have not been sought, but suitable locations for reservoirs could doubtless be found, as the basin contains some lakes and swamps.

Little is known of the available water power, but as the average fall is high, favorable sites are probably numerous. A few power sites not far from the mouth of the river have been developed, and at least one of these plants is of comparatively recent installation.

ESCANABA RIVER NEAR ESCANABA, MICH.

This station, which is located at a highway bridge between Escanaba and Gladstone, Mich., about 9 miles north of Escanaba and 4 miles above the mouth of the river, was established August 25, 1903. Discharge measurements were made at this station in April, May, and July, 1903, but daily gage heights were not obtained until August 25, 1903. The station was discontinued March 31, 1909, and reestablished June 1, 1909.

The chain gage is attached to the bridge, from which all measurements are made.

Although the current is swift at the measuring section, gage heights are affected by ice, which in some years covers the stream to a thickness of 2 feet for four months, and during the logging season the gage heights are sometimes affected by log jams.

This station was last inspected July 16, 1908. The accuracy of the daily and monthly discharge given below therefore depends on the permanency of flow and of elevation of the gage since that date. On November 6 the gage weight was lost, and hence all gage heights July 16, 1908, to November 5, 1910, are of necessity considered correct. A new chain and weight was installed November 15, 1910. Readings subsequent to that date are correct, provided there has been no change in the structure to which the gage is attached since July 16, 1908.

Conditions of flow are believed to be permanent. The gage reader at this station was paid by the Geological Survey of Michigan for 1910.

Daily gage height, in feet, of Escanaba River near Escanaba, Mich., for 1910.

[Miss Olive Beauchamp, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.2	.....	.....	4.3	4.1	2.7	1.8	1.8	2.3	2.2	2.7	2.2
2	.....	.....	.....	4.1	4.0	2.8	1.7	1.9	2.3	2.2	2.7	2.1
3	.....	.....	.....	4.0	3.6	2.7	1.7	2.0	2.2	2.4	2.6	2.1
4	.....	.....	.....	3.8	3.4	2.6	1.6	2.0	2.2	2.3	2.7	2.2
5	.....	3.3	3.3	3.9	3.5	2.7	1.5	1.8	2.2	2.8	2.7	2.1
6	.....	.....	.....	4.1	3.3	3.1	1.8	1.9	2.2	2.8	.....	2.0
7	.....	.....	.....	4.3	3.2	3.2	1.9	1.9	2.2	2.7	.....	2.1
8	3.7	.....	.....	4.2	3.2	2.9	1.8	1.8	2.2	2.5	.....	2.1
9	.....	.....	.....	4.1	2.9	2.7	1.9	1.9	2.0	2.3	.....	2.3
10	.....	.....	.....	3.9	2.9	2.6	1.8	1.8	2.1	2.3	.....	2.3
11	.....	.....	.....	3.7	2.8	2.6	1.8	1.9	2.1	2.2	.....	.....
12	.....	3.3	3.4	3.9	2.7	2.5	1.9	1.9	2.2	2.2	.....	.....
13	.....	.....	.....	3.8	2.7	2.4	1.8	1.8	2.4	2.2	.....	.....
14	.....	.....	.....	3.6	2.6	2.3	1.8	1.9	2.2	2.2	.....	3.0
15	3.5	.....	.....	3.7	2.6	2.4	1.8	2.0	2.2	2.2	2.3	.....
16	.....	.....	.....	3.5	2.6	2.3	1.9	1.9	2.1	2.1	2.3	.....
17	.....	.....	.....	3.6	2.7	2.3	2.0	1.9	2.0	2.1	2.3	.....
18	.....	.....	.....	3.7	3.0	2.2	1.8	1.9	2.0	2.1	2.2	.....
19	.....	3.1	3.5	3.7	3.5	2.2	1.6	1.8	2.0	2.1	2.2	.....
20	.....	.....	.....	3.6	3.5	2.0	1.6	1.8	2.0	2.1	2.3	.....
21	.....	.....	.....	3.4	3.6	2.1	1.7	1.8	2.0	2.2	2.3	2.9
22	3.4	.....	.....	3.3	3.5	2.0	1.9	1.9	1.9	2.3	2.2	.....
23	.....	.....	.....	3.4	3.4	1.9	1.8	2.5	2.0	2.3	2.2	.....
24	.....	.....	.....	3.5	3.3	1.8	1.9	2.5	2.2	2.3	2.2	.....
25	.....	.....	.....	3.5	3.3	2.0	2.0	2.6	2.2	2.4	2.2	.....
26	.....	3.4	.....	3.6	3.2	1.9	2.0	2.8	2.2	2.6	2.2	.....
27	.....	.....	.....	4.1	3.1	1.8	2.1	2.8	2.2	2.6	2.2	.....
28	.....	.....	.....	4.2	3.0	1.7	2.2	2.5	2.2	2.7	2.2	2.6
29	3.5	.....	.....	4.3	2.9	1.9	2.1	2.5	2.2	2.7	2.2	.....
30	.....	.....	.....	4.2	2.8	1.8	1.9	2.4	2.2	2.6	2.3	.....
31	.....	.....	.....	.....	2.8	.....	1.7	2.4	.....	2.6	.....	.....

NOTE.—River frozen over Jan. 1 to about Mar. 25 and Dec. 11–31. Gage heights during these periods taken to water surface. Ice varied in thickness from 0.5 to 2 feet.
The gage weight was lost Nov. 6 and replaced Nov. 15. (See description.)

Daily discharge, in second-feet, of Escanaba River near Escanaba, Mich., for 1910.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,860	2,530	790	205	205	480	410	790	410
2	2,530	2,380	880	165	250	480	410	790	350
3	2,380	1,810	790	165	300	410	550	710	350
4	2,090	1,550	710	205	300	410	480	790	410
5	2,230	1,680	790	90	205	410	880	790	350
6	2,530	1,420	1,180	205	250	410	880	760	300
7	2,860	1,300	1,300	250	250	410	790	730	.....
8	2,690	1,300	970	205	205	410	630	700	.....
9	2,530	970	790	250	250	300	480	670	.....
10	2,230	970	710	205	205	350	480	640	.....
11	1,950	880	710	205	250	350	410	600	.....
12	2,230	790	630	250	250	410	410	570	.....
13	2,090	790	550	205	205	550	410	540	.....
14	1,810	710	480	205	250	410	410	510	.....
15	1,950	710	550	205	300	410	410	480	.....
16	1,680	710	480	250	250	350	350	480	.....
17	1,810	790	480	300	250	300	350	480	.....
18	1,950	1,070	410	205	250	300	350	410	.....
19	1,950	1,680	410	125	205	300	350	410	.....
20	1,810	1,680	300	125	205	300	350	480	.....
21	1,550	1,810	350	165	205	300	410	480	.....
22	1,420	1,680	300	250	250	250	480	410	.....
23	1,550	1,550	250	205	630	300	480	410	.....
24	1,680	1,420	205	250	630	410	480	410	.....
25	1,680	1,420	300	300	710	410	550	410	.....
26	1,810	1,300	250	300	880	410	710	410	.....
27	2,530	1,180	205	350	880	410	710	410	.....
28	2,690	1,070	165	410	630	410	790	410	.....
29	2,860	970	250	350	630	410	790	410	.....
30	2,690	880	205	250	550	410	710	480	.....
31	.....	880	.....	165	550	.....	710	.....	.....

NOTE.—Daily discharge determined from a discharge rating curve well defined above 300 second-feet. Discharge Nov. 6–14 interpolated.

Monthly discharge of Escanaba River near Escanaba, Mich., for 1910.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	300	0.375	0.43	D.
February	.....	.....	250	.312	.32	D.
March	.....	.....	990	1.24	1.43	D.
April	2,860	1,420	2,150	2.69	3.00	B.
May	2,530	710	1,290	1.61	1.86	B.
June	1,300	165	546	.682	.76	B.
July	410	90	226	.282	.33	C.
August	880	205	367	.459	.53	B.
September	550	250	382	.478	.53	B.
October	880	350	536	.670	.77	B.
November	790	410	552	.690	.77	B.
December	.....	.....	275	.344	.40	D.
The year	.....	.....	656	.820	11.13	

NOTE.—Discharge during the period when ice existed estimated by means of climatologic records and comparison with records of Menominee River.
Mean discharge Dec. 7–31 estimated at 250 second-feet.
The accuracy of the discharge is somewhat uncertain. (See description.)

MENOMINEE RIVER BASIN.

GENERAL FEATURES.

Menominee River, throughout its length of about 104 miles, forms part of the boundary line between northern Michigan and Wisconsin, and its drainage basin therefore lies in both States. The river is formed by the junction of Michigamme and Brule rivers, and flows southeastward, emptying into Green Bay, an arm of Lake Michigan, near Menominee, Mich. Its total drainage area is about 4,000 square miles.

Michigamme River is said to rise in Lake Michigamme, the largest lake in the Menominee drainage basin, but the lake has a feeder which may be considered the continuation of the river and which rises within 12 miles of Lake Superior. The length of the Michigamme to its extreme source is about 72 miles; to Lake Michigamme about 51 miles. It is noteworthy that four of the largest tributaries enter the main stream above Iron Mountain, Mich., about three-fifths of the total drainage area being above this point. This characteristic increases the value of the stream for water-power development. Downstream from the Michigamme, on the right or west bank, the following important tributaries enter: Paint River, which is called a tributary of Brule River, although it is much the larger stream of the two and Brule, Pine, and Pemebonwon rivers, on the left or east bank are Sturgeon and Little Cedar rivers.

The drainage basin is narrow in its lower part and widest at the sources of the tributaries which form the rivers. The surface is in general covered deeply by glacial drift, but the Menominee and all its tributaries flow over crystalline rocks as far south as the mouth of Pike River, or fully two-thirds of its length. Below the mouth of the Pike the river flows over sandstones and limestones. Most of the rapids and falls occur in the area of crystalline rocks above the mouth of Pike River, although there are several rapids and falls below this point. The country through which the river flows is almost mountainous.

The Wisconsin tributaries rise in a high, flat plateau, abounding in lakes and swamps, among which Flambeau and Wisconsin rivers also head. Some of these rivers head in lakes only a few rods apart, and even in the same swamps in which the tributaries of the Menominee head. These lakes and swamps are nearly 1,600 feet above sea level, or about 1,000 feet above Lake Michigan. The Michigan branches flow from a similar region of equal or higher elevation. The numerous lakes and swamps make the flow of the river uniform and steady.

The elevation of the headwater streams is, as stated, about 1,600 feet above sea level; at the junction of Brule and Michigamme rivers

the elevation is about 1,300 feet; at the highway bridge near Iron Mountain, Mich., the elevation is about 1,050 feet; and at the mouth of the river it is 580 feet.

The mean annual rainfall is about 32 inches. The winters are severe, the snowfall being heavy and remaining on the ground for long periods, and the streams being ice covered from three to four months.

Probably all the first-class timber has been cut from this area, and that being cut at the present time is the smaller and less valuable timber that was left. The condition of the forests, so far as effect on run-off is concerned, does not differ greatly from their original condition, as the region is not thickly settled and a second growth soon springs up.

The feasibility of storage has not been fully investigated, but lakes and swamps are numerous and must afford many excellent reservoir sites. At the present time lumbermen store water for running logs, and the enlargement of many of the logging dams would undoubtedly give good-sized reservoirs.

Some excellent water-power sites have been developed on the main stream and tributaries, but many others, some of which have hardly been seen except by the lumbermen, are awaiting utilization. With opportunities for storage with which to produce a uniform and increased low-water flow, and with the favorable arrangement of its drainage basin, this river will in time be one of the biggest power producers in this section.

The river is still used for running logs, and the lumbermen's dams for holding water for flooding modify the normal flow of the stream considerably. Dams on the stream for power development should be so built as not to interfere with the use of water for log running.

Iron is mined at many places in the upper two-thirds of the basin and the section is fairly well covered with railroads.

MENOMINEE RIVER NEAR IRON MOUNTAIN, MICH.

This station, which is located at the Homestead highway bridge across Menominee River, about 3½ miles south of Iron Mountain, Mich., was established September 4, 1902, discontinued March 31, 1909, and reestablished June 5, 1909.

Pine River is tributary to the Menominee about 5 miles above the station.

The gage was formerly located on the right abutment of the bridge, from which all measurements are made, but on November 18, 1904, a chain gage was attached to the bridge in order to obtain gage readings during the winter months, as ice formed at the gage on the abutment.

The winters are severe in this locality, but as the current is swift the river is rarely entirely closed at this section. As is shown by the discharge measurements, however, there is backwater from ice below the station.

The stream is used extensively for logging and is subject to artificial control at times. Log jams often occur below the station and produce backwater at the gage. Except as above stated the station is an excellent one.

The gage reader's salary during 1910 was paid by the Penn Iron Mining Co., Vulcan, Mich., and the Oliver Iron Mining Co., Iron Mountain, Mich.

Discharge measurements of Menominee River near Iron Mountain, Mich., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Sept. 15	V. H. Reineking	200	727	0.82	971
Oct. 3	do	200	830	1.30	1,220
6	do	208	1,260	3.45	2,560
7	do	190	1,020	2.40	1,950

Daily gage height, in feet, of Menominee River near Iron Mountain, Mich., for 1910.

[A. J. St. Arnauld, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.5	2.4	1.7	5.7	6.0	3.1	4.0	1.1	2.1	0.9	1.6	0.8
2	2.5	2.4	1.7	6.2	6.0	3.6	0.9	1.1	1.0	0.9	1.5	0.8
3	2.7	2.4	1.7	6.0	6.2	3.6	3.4	1.1	2.0	1.3	1.5	0.8
4	2.7	2.4	1.7	5.7	4.3	3.5	1.0	2.5	2.0	3.4	1.4	0.8
5	2.6	2.5	1.7	5.7	4.3	4.9	1.1	1.8	1.4	3.7	1.3	0.8
6	2.6	2.4	1.7	4.4	4.3	4.5	0.9	1.5	1.0	4.4	1.2	0.8
7	2.6	2.4	1.7	5.5	4.2	3.2	0.9	1.2	2.8	2.4	1.2	0.8
8	2.6	2.4	1.7	6.4	3.8	3.0	0.6	1.2	1.0	2.4	1.2	0.8
9	2.8	2.3	1.9	5.5	3.4	3.9	0.8	1.0	1.8	2.0	1.1	0.8
10	2.8	2.3	2.3	5.8	2.4	1.7	1.0	1.0	1.1	1.5	1.1	0.8
11	3.0	2.3	2.3	5.5	2.9	2.1	1.4	1.0	1.1	1.5	1.1	1.0
12	3.0	2.3	2.3	4.8	2.5	2.1	1.4	0.9	1.1	1.2	1.1	1.0
13	3.2	2.3	2.3	4.1	2.6	1.7	1.0	0.8	1.8	1.0	1.1	1.0
14	3.3	2.3	2.3	3.3	2.6	1.5	1.6	0.8	1.1	1.0	1.1	.....
15	3.3	2.0	2.6	4.0	2.6	1.5	1.4	0.8	0.95	1.0	1.1	.....
16	3.3	2.0	2.9	4.1	2.6	1.6	1.4	0.8	0.8	1.1	1.0	.....
17	3.0	2.0	2.9	4.1	2.9	1.7	1.0	0.8	1.1	1.1	1.0	.....
18	3.0	2.0	3.1	4.1	2.9	1.7	1.0	0.8	0.9	1.1	1.0	1.6
19	2.8	2.0	3.1	4.8	2.6	3.0	1.0	0.8	1.5	1.1	1.0	.....
20	2.6	2.0	3.7	5.6	5.0	3.2	0.6	0.8	1.1	1.1	1.0	.....
21	2.6	1.8	4.9	3.3	4.4	0.8	0.6	.....	0.8	1.1	1.0	.....
22	2.6	1.8	6.7	3.3	7.5	0.8	0.6	.....	0.8	1.6	1.0	.....
23	2.6	1.8	4.7	3.3	3.3	1.9	0.6	.....	1.0	1.9	1.0	.....
24	2.6	1.8	5.4	3.3	4.5	0.9	1.0	.....	0.9	1.9	0.9	.....
25	2.4	1.8	6.2	4.4	2.8	0.9	1.4	.....	0.8	1.8	0.9	.....
26	2.4	1.7	6.2	4.8	2.9	0.7	1.8	.....	0.9	1.7	0.9	1.6
27	2.4	1.7	6.2	5.3	3.1	0.7	2.0	.....	1.1	1.7	0.9	.....
28	2.4	1.7	6.2	6.0	3.0	3.6	1.8	.....	1.2	1.6	0.9	.....
29	2.4	.....	5.7	5.5	6.4	0.8	1.6	.....	1.1	1.6	0.9	.....
30	2.4	.....	5.4	6.0	7.4	3.4	1.6	.....	1.5	1.6	0.8	.....
31	2.4	.....	5.5	.....	4.1	.....	1.4	.....	.....	1.6	.....	.....

NOTE.—River open at gage during winter months but relations between gage height and discharge was affected by ice below the station Jan. 1 to about Mar. 20, and about Dec. 10 to 31.
No information available regarding backwater from log jams.

Daily discharge, in second-feet, of Menominee River near Iron Mountain, Mich., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4,400	4,680	2,290	2,960	1,080	1,620	985	1,340	940
2	.....	4,870	4,680	2,660	985	1,080	1,030	985	1,280	940
3	.....	4,680	4,870	2,660	2,510	1,080	1,560	1,180	1,280	940
4	.....	4,400	3,180	2,580	1,030	1,880	1,560	2,510	1,220	940
5	.....	4,400	3,180	3,660	1,080	1,440	1,220	2,740	1,180	940
6	.....	3,260	3,180	3,340	985	1,280	1,030	3,260	,120	940
7	.....	4,200	3,110	2,360	985	1,120	2,080	1,820	1,120	940
8	.....	5,060	2,810	2,220	860	1,120	1,030	1,820	1,120	940
9	.....	4,200	2,510	2,880	940	1,030	1,440	1,560	1,080	940
10	.....	4,490	1,820	1,390	1,030	1,030	1,080	1,280	1,080	940
11	.....	4,200	2,150	1,620	1,220	1,030	1,080	1,280	1,080	.....
12	.....	3,580	1,880	1,620	1,220	985	1,080	1,120	1,080	.....
13	.....	3,040	1,940	1,390	1,030	940	1,440	1,030	1,080	.....
14	.....	2,440	1,940	1,280	1,340	940	1,080	1,030	1,080	.....
15	.....	2,960	1,940	1,280	1,220	940	1,010	1,030	1,080	.....
16	.....	3,040	1,940	1,340	1,220	940	940	1,080	1,030	.....
17	.....	3,040	2,150	1,390	1,030	940	1,080	1,080	1,030	.....
18	.....	3,040	2,150	1,390	1,030	940	985	1,080	1,030	.....
19	.....	3,580	1,940	2,220	1,030	940	1,280	1,080	1,030	.....
20	.....	4,300	3,750	2,360	860	940	1,080	1,080	1,030	.....
21	3,660	2,440	3,260	940	860	.....	940	1,080	1,030	.....
22	5,360	2,440	6,180	940	860	.....	940	1,340	1,030	.....
23	3,500	2,440	2,440	1,500	860	.....	1,030	1,500	1,030	.....
24	4,110	2,440	3,340	985	1,030	.....	985	1,500	985	.....
25	4,870	3,260	2,080	985	1,220	.....	940	1,440	985	.....
26	4,870	3,580	2,150	900	1,440	.....	985	1,390	985	.....
27	4,870	4,020	2,290	900	1,560	.....	1,080	1,390	985	.....
28	4,870	4,680	2,220	2,660	1,440	.....	1,120	1,340	985	.....
29	4,400	4,200	5,060	940	1,340	.....	1,080	1,340	985	.....
30	4,110	4,680	6,080	2,510	1,340	.....	1,280	1,340	940	.....
31	4,200	.....	3,040	.....	1,220	.....	.....	1,340	.....	.....

NOTE.—Daily discharge determined from a well-defined discharge rating curve.

Monthly discharge of Menominee River near Iron Mountain, Mich., for 1910.

[Drainage area, 2,420 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	1,000	0.413	0.48	D.
February	.....	.....	800	.331	.37	D.
March	5,360	.....	2,260	.934	1.08	C.
April	5,060	2,440	3,710	1.53	1.71	B.
May	6,180	1,820	3,030	1.25	1.44	B.
June	3,660	900	1,840	.760	.85	B.
July	2,960	860	1,220	.504	.58	B.
August	1,880	940	1,410	.583	.67	B.
September	2,080	940	1,170	.483	.54	A.
October	3,260	985	1,420	.587	.68	A.
November	1,340	940	1,080	.446	.50	A.
December	.....	.....	850	.351	.40	C.
The year	6,180	.....	1,650	.682	9.30	

NOTE.—Average discharge Aug. 21-31 estimated 2,000 second-feet.
Discharge for the period during which ice existed estimated by means of climatologic records and comparison with Escanaba River.
Mean discharge Mar. 1-20 estimated 1,060 second-feet. Mean discharge Dec. 11-31 estimated 807 second-feet.

WOLF RIVER BASIN.

GENERAL FEATURES.

Wolf River rises in a number of small lakes in the western part of Forest County, in northeastern Wisconsin, flows southward and unites with upper Fox River at a point about 10 miles west of Lake Winnebago. Though nominally a branch of Fox River it is really the master stream, as its discharge is more than three times that of the Fox. It is about 180 miles long and its drainage area comprises about 3,600 square miles. All the largest tributaries are from the west, the more important ones (beginning at the source) being West Wolf, Red, Embarrass, Little Wolf, and Waupaca rivers.

The basin is about 110 miles long and 35 miles in average width.

In the upper half of its course the river flows over crystalline rocks and descends very rapidly. At the Chicago & Northwestern Railway crossing, 2 miles west of Lenox, the elevation of the river is 1,560 feet; in the 80 miles between this point and Shawano the river descends, in many rapids and falls, about 770 feet, or nearly 10 feet to the mile. Shawano marks the point of transition from ancient crystalline rocks to sandstones, and here the river also crosses the old coast line of Lake Michigan and enters the region of red clay. Below Shawano, which is the head of navigation, the stream is sluggish, its descent being only 42 feet to Lake Winnebago, a distance of 80 miles. The banks are low, and in high water the adjoining flats are covered with water for several miles from the river.

Lumbering has been carried on very extensively in this area, and all the best timber has been cut off. At present time the run of logs is small, and a great part of the timber is used for making paper pulp. Above Shawano the drainage basin is thinly settled, and the condition of the forests, so far as it affects the run-off of the river, shows little change from original conditions, as a second growth has sprung up after the operations of the lumbermen.

The mean annual rainfall in this part of Wisconsin is about 32 inches. The winters are severe. Snowfall is comparatively heavy and lasts for considerable periods. Ice forms on the river from 1 to 2 feet in thickness and remains for about three months.

The feasibility of storage has not been investigated, but the lakes and swamps in the basin must afford opportunities for making reservoirs. The lumbermen have built many dams for holding water for flooding logs, and by increasing the height of these dams large reservoirs could undoubtedly be created.

Excellent sites for water power exist and their development awaits only a demand for power. A few power plants have already been put in operation.

LITTLE WOLF RIVER NEAR NORTHPORT, WIS.[1]

This station, which is located at the highway bridge known as Phillips bridge, about 3 miles southwest of Northport, Wis., in the southeastern part of sec. 8, T. 22 N., R. 14 E., about 3 miles from Wolf River, was established October 13, 1907, and discontinued December 31, 1910. The station was established and maintained by D. W. Mead, who furnished the records.

The drainage area above the section is about 460 square miles.

The stream is covered with ice 1 to 2 feet thick for about three months each year.

A staff gage is attached to the right abutment of the bridge, from which discharge measurements are made. So far as known, the datum of the gage has remained unchanged.

Daily gage height, in feet, of Little Wolf River near Northport, Wis., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.6	2.7	2.2	3.7	1.8	1.3	1.2	1.6	1.6	1.4	1.5
2	2.4	2.6	2.7	2.3	3.6	1.5	1.3	1.2	1.6	1.6	1.4	1.9
3	2.5	2.6	2.7	2.2	3.5	1.4	1.2	1.2	1.6	1.4	1.4	1.8
4	2.5	2.5	2.8	1.9	3.3	1.5	1.2	1.1	1.6	1.6	1.3	1.9
5	2.5	2.6	2.8	2.0	3.3	1.5	1.2	1.1	1.6	1.7	1.3	1.8
6	2.5	2.6	3.0	2.3	3.2	1.8	1.2	1.1	1.7	1.7	1.5	1.9
7	2.5	2.6	2.7	2.4	2.8	1.8	1.3	1.2	1.8	1.5	1.3	1.8
8	2.5	2.5	3.3	2.8	2.8	1.9	1.2	1.1	1.7	1.4	1.4	2.0
9	2.5	2.6	3.2	2.5	2.5	1.5	1.2	1.1	1.7	1.4	1.3	1.9
10	2.5	2.6	3.3	2.6	2.3	1.6	1.2	1.2	1.6	1.3	1.4	1.9
11	2.6	2.5	3.0	2.4	1.8	1.5	1.1	1.2	1.5	1.3	1.5	1.8
12	2.6	2.5	3.0	2.2	1.6	1.5	1.2	1.1	1.7	1.2	1.5	1.8
13	2.5	2.6	4.8	1.8	1.6	1.5	1.2	1.2	2.0	1.2	1.5	1.9
14	2.6	2.6	4.7	2.4	1.5	1.5	1.2	1.2	2.4	1.2	1.4	1.8
15	2.6	2.7	4.7	1.8	1.5	1.4	1.2	1.3	2.6	1.3	1.3	1.8
16	.....	2.6	4.8	2.0	1.5	1.4	1.2	1.3	1.8	1.4	1.6	1.7
17	.....	2.6	4.7	1.9	1.6	1.4	1.2	1.3	1.7	1.4	1.4	1.7
18	.....	2.5	4.5	2.1	1.8	1.4	1.2	1.2	1.7	1.3	1.1	1.7
19	.....	2.5	4.2	2.2	1.8	1.4	1.1	1.3	1.7	1.3	1.2	1.7
20	.....	2.7	3.5	2.5	2.0	1.4	1.1	1.2	1.6	1.2	1.5	1.7
21	.....	2.6	3.4	2.5	1.9	1.3	1.1	1.2	1.5	1.2	1.3	1.7
22	.....	2.6	3.2	2.4	1.6	1.3	1.2	1.2	1.5	1.5	1.5	1.7
23	2.7	2.6	3.0	2.6	1.7	1.3	1.1	1.4	1.5	1.6	1.3	1.8
24	2.6	2.6	3.2	3.7	1.9	1.3	1.3	1.6	1.6	1.4	1.3	1.8
25	2.6	2.6	3.2	4.4	1.7	1.3	1.3	1.5	1.6	1.3	1.5	1.7
26	2.6	2.7	3.1	4.7	1.7	1.3	1.1	1.4	1.7	1.2	1.4	1.7
27	2.6	3.0	2.8	4.8	1.6	1.3	1.2	1.5	1.9	1.2	1.3	1.8
28	2.9	2.5	2.7	4.5	1.5	1.2	1.2	1.5	2.1	1.3	1.4	1.9
29	2.7	.....	2.6	4.2	1.7	1.2	1.3	1.4	1.6	1.2	1.4	1.9
30	2.5	.....	2.6	4.2	1.7	1.3	1.2	1.6	1.7	1.2	1.2	1.9
31	2.7	.....	2.5	.....	1.6	.....	1.2	1.7	.....	1.3	.....	1.9

NOTE.—Relation of gage height to discharge probably affected by ice during January, February, March, and December.

GRAND RIVER BASIN.

GENERAL FEATURES.

Grand River rises in the southern part of Jackson County, in the southeast-central part of Michigan, flows northward to Lansing, thence northwestward to the central part of Ionia County, and

[1] Information in regard to this stream is contained in Bull. Wisconsin Geol. and Nat. Hist. Survey No. 20, entitled "The water powers of Wisconsin," by Leonard S. Smith.

finally westward to Grand Haven, Mich., where it enters Lake Michigan. Its length by general course is about 200 miles, but following the numerous bends the distance is at least 300 miles. The principal tributaries, beginning at the source, are: From the right, Portage, Red Cedar, Lookingglass, Maple, Flat, and Rogue rivers; from the left there is only one of any importance, Thornapple River. The total drainage area is about 5,570 square miles, which makes it the largest stream in Michigan.

The drainage basin is fairly regular in outline. It lies at the southern border of the pine belt and is for the most part cleared and is now thickly settled, having become a rich agricultural region. The area is overlain with glacial drift with outcroppings of rock at rare intervals. At Grand Rapids, which is the head of navigation, the stream passes over a limestone ledge, making a considerable fall at Grand Ledge. About 12 miles west of Lansing there is a similar descent over sandstone. Below Grand Rapids the flow is very sluggish. In the upper half of this stretch the banks of the river are locally high, forming natural levees; below Lamont bayous and swamps are common between the river banks and the foothills bordering the valley. The valley of the river proper is narrow; gravel bluffs from 50 to 60 feet high stand close to the stream in some places. The northwestern and southeastern portions of the basin are thickly interspersed with small lakes, a number of which have no surface outlet.

The elevation of the sources of the river is about 1,000 feet; at Lansing the elevation is about 820 feet; at Grand Rapids it is about 590 feet; at the mouth of the river the elevation is 581 feet; the total descent is therefore about 400 feet, which produces a rather low average fall.

The basin contains no noteworthy forested areas, all timber having been cut off some years ago.

The mean annual rainfall is 30 to 35 inches. The winters are comparatively mild. In general the snowfall is not heavy and ice does not form very thick.

Storage sites have not been investigated, but it is thought that some of the lakes and swamps might be converted into good-sized reservoirs by means of dams of ordinary height.

The stream is of considerable value for water power, and some sites are still undeveloped. At the present time about 5,000 horsepower is developed at the larger plants on the main stream and tributaries.

GRAND RIVER AT GRAND RAPIDS, MICH.

This station, which is located at the Fulton Street Bridge in Grand Rapids, Mich., was established March 12, 1901.

The drainage area above the station is about 4,900 square miles.

In November, 1907, a new staff gage, with zero corresponding to the city datum, was attached to the bridge, from which discharge measurements are made. Readings taken on this gage were first reported in December, 1907. The zero of the gage in use prior to November, 1907, was 0.55 foot below the city datum. All gage readings, however, have been corrected to the city datum, and all published gage heights are therefore referred to the same datum.

Ice forms in winter and changes the relation between gage heights and discharge. The operation of power plants above the section modifies the low-water flow.

The two or three measurements that have been taken at this station since 1905 indicate that the 1905 discharge table does not hold after that year; therefore estimates for the flow for later years have not been made. This station was last inspected October 21, 1908.

The records are furnished by the city engineer of Grand Rapids.

Daily gage height, in feet, of Grand River at Grand Rapids, Mich., for 1910.

[F. F. Smith, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.85	2.02	0.50	.....	1.05	—0.65	—0.80	—0.68	—0.50	—0.45	—0.58
2	.....	1.85	3.30	.50	3.35	1.12	— .70	— .80	— .72	.....	— .45	— .58
3	3.00	1.75	4.85	.....	4.40	1.30	.....	— .80	— .78	— .52	— .40	— .58
4	3.00	1.65	6.05	.25	5.58	1.55	.....	— .80	.....	— .28	— .38	.....
5	3.00	1.60	7.50	.30	5.95	.....	— .80	— .88	.....	.00	— .38	— .58
6	3.05	.....	10.83	.20	6.00	1.85	— .85	— .90	— .75	— .05	.....	— .58
7	3.00	1.65	11.78	.30	5.85	2.35	— .85	.....	— .70	— .05	— .40	— .58
8	2.90	1.65	12.42	.30	.....	2.15	— .88	— .80	— .60	— .1	— .38	— .58
9	.....	1.70	12.28	.40	4.40	1.82	— .80	— .90	— .70	.....	— .38	— .58
10	2.50	2.00	11.48	.....	3.60	1.55	.....	— .85	— .68	— .05	— .42	— .58
11	2.45	1.65	10.48	.15	2.85	1.15	— .70	—1.00	.....	— .22	— .58	.....
12	2.55	1.30	9.32	.05	2.60	.....	— .65	— .80	— .60	— .32	— .55	— .58
13	2.40	.....	.....	— .15	1.82	.70	— .65	— .90	— .48	— .42	.....	— .55
14	2.55	1.20	8.32	— .20	1.22	.45	— .70	.....	— .40	— .50	— .58	— .55
15	2.60	.95	6.45	— .30	.....	.10	— .70	— .90	— .40	— .65	— .58	— .55
16	.....	.95	5.45	— .35	.72	.15	— .80	— .95	— .40	.....	— .58	— .55
17	2.45	1.00	4.75	.....	.75	— .05	.....	— .90	— .42	— .58	— .58	— .55
18	2.30	1.15	4.20	.25	.80	— .05	— .75	— .90	.....	— .45	— .58	.....
19	2.35	1.28	3.55	.88	.68	.....	— .85	— .90	— .45	— .48	— .58	— .55
20	2.22	.....	.....	.80	.50	— .15	— .85	— .85	— .50	— .45	.....	— .55
21	2.05	1.42	3.40	.55	.50	— .22	— .85	.....	— .55	— .40	— .52	— .55
22	2.18	.....	3.55	.45	.....	— .45	— .85	— .90	— .50	— .38	— .60	— .55
23	.....	1.58	2.85	.50	2.22	— .55	— .88	— .52	— .45	.....	— .58	— .55
24	2.25	1.40	2.60	.....	3.58	— .50	.....	— .50	— .55	— .35	.....	— .55
25	2.65	1.50	2.30	.25	3.72	— .55	— .65	— .55	.....	— .30	— .55	.....
26	2.60	1.60	1.95	1.15	3.35	.....	— .65	— .55	— .45	— .32	— .58	.....
27	2.60	.....	.....	2.22	2.75	— .50	— .70	— .55	— .52	— .45	.....	— .62
28	2.55	1.90	1.25	2.70	2.20	— .60	— .60	.....	— .52	— .45	— .58	— .68
29	2.30	.....	1.60	3.28	.....	— .60	— .60	— .60	— .50	— .40	— .58	— .72
30	.....	.....	1.30	3.60	.....	— .65	— .70	— .60	— .48	.....	— .55	— .72
31	2.05	.....	.75	.....	1.15	.....	.....	— .62	.....	— .45	.....	— .72

MANISTEE RIVER BASIN.

GENERAL FEATURES.

Manistee River rises in several lakes along the boundary line between Antrim and Otsego counties in the north-central part of Michigan, flows southwestward across Kalkaska, Wexford, and Manistee counties, and empties into Lake Michigan at Manistee, Mich. It has but two important tributaries, both of which enter in the lower part of the river—Big Bear on the right and the South Branch of the Manistee on the left. The length of the river is about 110 miles, not taking into account the numerous bends and angles; but following its windings its total length must be about 200 miles, for it is very crooked. The drainage area comprises about 2,120 square miles.

The soil of the area is sandy, and the stream derives a large part of its supply from springs along the banks of the main river and its tributaries. The country is flat or rolling. The elevation of the sources of the river is about 1,200 feet and the elevation of the mouth is 581 feet, a total fall of 620 feet.

Practically all the better timber has been cut from this area, although lumbering is still carried on to some extent.

The mean annual rainfall is about 35 inches. The winters are not severe. There is a fairly heavy fall of snow, and ice forms on the river about 1 foot in thickness during severe cold spells. The large amount of spring water helps to keep the river open.

Storage problems have not been studied, but as the basin contains many lakes it must afford conditions for creating reservoirs to conserve and regulate the flow.

The opportunities for water power have not been fully investigated. Good sites, however, must be available at various places, as the fall of the river is considerable and the flow is well sustained during dry spells by the numerous springs.

The stream is used considerably for logging, but the lumber interests are becoming less every year.

MANISTEE RIVER NEAR SHERMAN, MICH.

This station, which is located at North Bridge, about 1 mile from Sherman, Mich., was established July 10, 1903.

Wheeler Creek enters immediately below the station.

The river freezes over in winter, making necessary special studies to determine the winter flow. The constancy of flow of this stream, as shown in the following tables, is remarkable and is due to springs and ground-water flow. The maximum recorded mean flow for any month from 1903 to 1910 is only $2\frac{1}{2}$ times the minimum recorded mean flow. It has consequently been possible to make fairly close

estimates of the discharge for the periods during which ice was present by taking advantage of these facts and by utilizing climatologic data.

The stream is used for logging, and at times sunken logs in the bed of the stream may affect the gage heights.

The chain gage is attached to the bridge, from which all discharge measurements are made. The datum of the gage has remained unchanged.

The records are reliable and accurate prior to the last inspection by the Survey, October 23, 1908, except as conditions noted above may affect the gage readings. The chain length was found to be correct March 1, 1910, and a measurement made in 1911 indicates that the datum of the gage and the relation of gage height to discharge have remained unchanged. Conditions of flow are believed to be permanent.

The gage reader's salary has been paid for 1910 by William G. Fargo, Jackson, Mich.

Daily gage height, in feet, of Manistee River near Sherman, Mich., for 1910.

[F. G. Bullock, observer.]

Days.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.40	2.10	2.20	3.60	3.00	2.45	2.10	1.85	2.30	2.05	2.71	2.60
2	2.40	2.10	2.20	3.45	2.85	2.45	2.10	1.82	2.30	1.98	3.05	2.57
3	2.45	2.05	2.22	3.25	2.70	2.45	2.00	1.85	2.20	2.00	3.05	2.50
4	2.45	2.05	2.30	3.20	2.60	2.45	1.90	1.90	2.10	2.10	2.92	2.49
5	2.45	2.00	2.30	3.15	2.60	2.45	1.80	1.85	2.10	2.10	2.82	2.42
6	2.45	1.95	2.40	3.15	2.50	2.45	1.80	1.80	2.02	2.10	2.72	2.37
7	2.45	2.00	2.80	3.20	2.40	2.45	1.85	1.78	1.95	2.10	2.62	2.29
8	2.45	2.10	2.80	3.15	2.40	2.40	1.90	1.75	1.95	2.10	2.60	2.29
9	2.40	2.10	2.70	3.05	2.35	2.30	1.90	1.75	2.10	2.10	2.60	2.24
10	2.45	2.20	2.80	3.05	2.30	2.30	2.28	1.75	2.10	2.10	2.65	2.19
11	2.40	2.20	2.80	2.95	2.30	2.30	2.35	1.75	2.12	2.10	2.68	2.20
12	2.40	2.20	2.70	2.82	2.25	2.30	2.30	1.75	2.32	2.10	2.80	2.36
13	2.40	2.10	2.55	2.75	2.20	2.20	2.22	1.75	2.48	2.10	2.80	2.35
14	2.40	2.10	2.60	2.60	2.20	2.20	2.20	1.75	2.50	2.10	2.74	2.20
15	2.40	2.10	2.60	2.52	2.20	2.10	2.10	1.75	2.50	2.10	2.69	2.20
16	2.30	2.00	2.52	2.52	2.20	2.10	2.00	1.92	2.45	2.02	2.66	2.21
17	2.30	2.00	2.60	2.50	2.25	2.05	1.90	2.05	2.45	2.00	2.58	2.20
18	2.30	1.92	2.70	2.50	2.30	2.00	1.85	2.10	2.38	2.00	2.48	2.20
19	2.25	1.90	2.70	2.42	2.30	2.00	1.85	2.10	2.20	1.98	2.38	2.20
20	2.20	2.00	3.25	2.40	2.30	2.00	1.85	2.00	2.15	1.98	2.30	2.20
21	2.20	1.98	3.60	2.40	2.35	2.00	1.82	2.00	2.15	2.04	2.30	2.20
22	2.20	1.95	4.10	2.35	2.35	2.00	1.80	1.90	2.15	2.10	2.30	2.14
23	2.20	1.95	4.35	2.35	2.42	2.00	1.80	2.25	2.15	2.10	2.38	2.18
24	2.20	1.90	4.32	2.35	2.52	2.00	2.12	2.40	2.15	2.10	2.52	2.30
25	2.20	2.00	4.40	2.45	2.50	2.00	2.18	2.35	2.15	2.10	2.55	2.18
26	2.20	2.00	4.40	2.82	2.48	2.00	2.00	2.50	2.15	2.09	2.60	2.10
27	2.20	2.10	4.30	3.15	2.45	2.00	2.00	2.55	2.15	2.32	2.60	2.10
28	2.30	2.10	4.30	3.20	2.45	2.00	2.00	2.55	2.12	2.55	2.60	2.18
29	2.20	.....	4.15	3.20	2.50	2.00	1.90	2.48	2.10	2.70	2.62	2.20
30	2.10	.....	4.10	3.10	2.50	2.05	1.90	2.40	2.05	2.70	2.61	2.26
31	2.10	.....	3.90	.....	2.50	.....	1.85	2.40	.....	2.70	.....	2.22

NOTE.—No information regarding ice, but the gage heights were apparently affected little if any by the presence of ice during the winter months.

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Daily discharge, in second-feet, of Manistee River near Sherman, Mich., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,020	917	952	1,500	1,250	1,040	917	834	987	900	1,140	1,100
2	1,020	917	952	1,440	1,190	1,040	917	825	987	876	1,270	1,090
3	1,040	900	959	1,360	1,140	1,040	883	834	952	883	1,270	1,060
4	1,040	900	987	1,330	1,100	1,040	850	850	917	917	1,220	1,060
5	1,040	883	987	1,310	1,100	1,040	819	834	917	917	1,180	1,030
6	1,040	866	1,020	1,310	1,060	1,040	819	819	890	917	1,140	1,010
7	1,040	883	1,170	1,330	1,020	1,040	834	813	866	917	1,100	984
8	1,040	917	1,170	1,310	1,020	1,020	850	804	866	917	1,100	984
9	1,020	917	1,140	1,270	1,000	987	850	804	917	917	1,100	966
10	1,040	952	1,170	1,270	987	987	980	804	917	917	1,120	948
11	1,020	952	1,170	1,230	987	987	1,000	804	924	917	1,130	952
12	1,020	952	1,140	1,180	970	987	987	804	994	917	1,170	1,010
13	1,020	917	1,080	1,150	952	952	959	804	1,050	917	1,170	1,000
14	1,020	917	1,100	1,100	952	952	952	804	1,060	917	1,150	952
15	1,020	917	1,100	1,070	952	917	917	804	1,060	917	1,130	952
16	987	883	1,070	1,070	952	917	883	857	1,040	890	1,120	956
17	987	883	1,100	1,060	970	900	850	900	1,040	883	1,090	952
18	987	857	1,140	1,060	987	883	834	917	1,020	883	1,050	952
19	970	850	1,140	1,030	987	883	834	917	952	876	1,020	952
20	952	883	1,360	1,020	987	883	834	883	934	876	987	952
21	952	876	1,500	1,020	1,000	883	825	883	934	897	987	952
22	952	866	1,730	1,000	1,000	883	819	850	934	917	987	931
23	952	866	1,840	1,000	1,030	883	819	970	934	917	1,020	945
24	952	850	1,830	1,000	1,070	883	924	1,020	934	917	1,070	987
25	952	883	1,870	1,040	1,060	883	945	1,000	934	917	1,080	945
26	952	883	1,870	1,180	1,050	883	883	1,060	934	914	1,100	917
27	952	917	1,820	1,310	1,040	883	883	1,080	934	994	1,100	917
28	987	917	1,820	1,330	1,040	883	883	1,080	924	1,080	1,100	945
29	952	.....	1,750	1,330	1,060	883	850	1,050	917	1,140	1,100	952
30	917	.....	1,730	1,290	1,060	900	850	1,020	900	1,140	1,100	973
31	917	.....	1,640	.....	1,060	.....	834	1,020	.....	1,140	.....	959

NOTE.—Daily discharge determined from a discharge rating curve well defined below 1,700 second-feet.

Monthly discharge of Manistee River near Sherman, Mich., for 1910.

[Drainage area, 900 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	1,040	917	992	1.10	1.27	B.
February	952	850	901	1.00	1.04	B.
March	1,870	952	1,330	1.48	1.71	B.
April	1,500	1,000	1,200	1.33	1.48	A.
May	1,250	952	1,030	1.14	1.31	A.
June	1,040	883	946	1.05	1.17	A.
July	1,000	819	880	.978	1.13	A.
August	1,080	804	895	.994	1.15	A.
September	1,060	866	952	1.06	1.18	A.
October	1,140	876	937	1.04	1.20	A.
November	1,270	987	1,110	1.23	1.37	A.
December	1,100	917	977	1.09	1.26	B.
The year	1,870	804	1,010	1.12	15.27	

NOTE.—Accuracy for January, February, March, and December reduced on account of the possibility of ice effect.

BASINS TRIBUTARY TO LAKE HURON.

AU SABLE RIVER BASIN.

GENERAL FEATURES.

The drainage basin of Au Sable River lies in the northeastern part of Michigan. The river rises in the heart of the plateau region in the central part of northern Michigan, in the southern part of Otsego County, flows southward along the western side of Crawford County to Grayling, then turns and flows eastward across Crawford and Oscoda counties, thence southeastward, and enters Lake Huron at Au Sable. The South Branch and the North Branch are the principal tributaries. The river is about 100 miles long, not following the bends, and its total drainage area comprises about 2,010 square miles.

Along the lower 20 miles of the river the basin is narrow, the average width being about 5 miles, but farther up the width increases to about 30 miles. The area is underlain by shales which have been so deeply covered with glacial drift that rock outcrops are rare. The upper end of the narrow part of the basin is rolling and hilly; the lower part is level and undulating. In its wider part the basin consists chiefly of sand and gravel plains with undrained hollows. The elevation of the sources of the river is about 1,250 feet; at Bamfield, about 40 miles from the mouth, following the river, the elevation is about 850 feet; the elevation at the mouth is 581 feet.

This district was at one time noted for its white pine, but the area is now almost entirely cleared of its valuable native timber and is in great part covered with scrub conifers.

The mean annual rainfall is 30 to 35 inches. It is possible that deforestation has increased the flow of this stream by allowing the rainfall to be entirely absorbed by the sand and gravel soil. The water thus absorbed reappears as springs. The springs, which occur wherever the streams have cut down through the sand and gravel to the underlying clay, help maintain the flow of the stream in dry periods and tend to keep the river open during the winter months, although the winters are severe, snowfall being comparatively heavy and ice of considerable thickness forming on the streams.

The arrangement of this basin is very favorable for water-power developments, as three-fourths of the area lies above the narrow part, in which the sites are found. Along this section the bed of the stream is of firm clay and in many places the river is flanked by high terraced clay cliffs rising 60 to 100 feet above it. Extensive investigations are now being made preparatory to developing the power.

The river is still used for logging, but the run of logs is small.

AU SABLE RIVER AT BAMFIELD, MICH.

This station, which is located at the steel highway bridge at Bamfield, Mich., was established August 27, 1902.

The measuring section formerly used was at a wooden bridge about 400 feet above the new steel bridge from which measurements are

now made. The steel bridge was begun in March, 1907, and finished in July, 1907.

The staff gage, which is fastened to a pier of the old bridge, is unchanged, and the section at the gage has not been altered in any way. A slight backwater effect has, however, been caused at the section where the gage is located by changes made in the channel below the gage at the time of the erection of the new steel bridge. The determinations of monthly discharge from March, 1907, to December, 1908, as published in Water-Supply Paper 244, are about 4 per cent or less in excess of their true values according to stage.

It is probable that the river is used for log driving only in the spring of the year, for during the summer and fall the gage heights are fairly uniform. As sunken logs are removed from the river twice each year they have little if any effect on the gage readings.

Winters are severe in this locality. The river generally freezes over, but does not remain closed longer than one or two months. Any increase in gage height during the winter months, unless caused by a thaw, is generally caused by backwater from ice jams formed by anchor ice.

Because of changes in channel, the estimates for 1910 are withheld until more data are available.

Daily gage height, in feet, of Au Sable River at Bamfield, Mich., for 1910.

[Mrs. W. H. Bamfield, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.25	.....	.....	2.44	1.88	1.68	0.98	0.90	1.40	1.11	1.47	1.34
2	.....	.....	3.45	2.35	1.83	1.71	.92	.91	0.98	1.10	1.50	1.39
3	.....	.....	.....	2.09	1.79	1.66	.90	.92	0.91	1.20	1.47	1.44
4	.....	3.10	.....	2.05	1.71	1.58	.84	.96	1.08	1.26	1.42	1.41
5	.....	.....	3.22	1.98	1.60	1.52	.89	.86	1.15	1.45	1.39	1.38
6	.....	.....	2.61	2.02	1.50	1.62	.97	.92	1.45	1.54	1.42	1.38
7	.....	.....	1.70	2.05	1.52	1.55	1.00	.99	1.38	1.50	1.48	1.30
8	.....	.....	1.79	2.09	1.42	1.48	1.50	.96	1.46	1.41	1.47	1.36
9	.....	3.70	1.78	2.10	1.40	1.46	1.45	.98	1.30	1.34	1.50	1.41
10	.....	.....	1.80	2.03	1.41	1.35	1.40	.89	1.22	1.22	1.50	1.50
11	.....	.....	1.55	1.96	1.44	1.31	1.80	.98	1.26	1.16	1.39	1.42
12	4.00	.....	2.00	1.94	1.38	1.31	1.30	1.01	1.45	1.18	1.44	1.30
13	.....	.....	2.15	1.80	1.38	1.28	1.06	1.06	1.71	1.14	1.49	1.30
14	.....	.....	2.34	1.75	1.40	1.20	1.11	1.02	1.68	1.10	1.39	1.40
15	.....	.....	2.46	1.70	1.44	1.24	1.19	1.11	1.55	1.10	1.34	1.29
16	.....	.....	2.72	1.73	1.40	1.26	1.32	1.50	1.40	1.05	1.30	1.22
17	.....	.....	2.76	1.83	1.36	1.31	1.19	1.25	1.40	1.02	1.47	1.20
18	.....	.....	2.72	1.88	1.31	1.30	1.05	1.10	1.44	1.03	1.48	1.19
19	3.25	3.80	2.78	1.90	1.44	1.26	1.00	.98	1.40	1.00	1.48	1.11
20	.....	.....	2.72	1.92	1.48	1.31	.98	.94	1.32	1.11	1.44	1.19
21	.....	.....	2.84	1.98	1.44	1.40	.96	1.10	1.41	1.34	1.32	1.12
22	.....	.....	3.44	1.98	1.46	1.29	1.00	1.11	1.33	1.50	1.26	1.10
23	.....	3.35	3.52	1.94	1.56	1.26	1.04	1.04	1.24	1.41	1.24	3.70
24	.....	.....	3.62	1.96	1.76	1.17	1.35	1.00	1.22	1.30	1.20	3.10
25	.....	.....	3.49	1.81	1.85	1.09	1.10	1.10	1.30	1.30	1.24	3.00
26	3.00	.....	3.36	2.00	1.68	1.08	1.65	1.16	1.32	1.54	1.25	2.90
27	.....	.....	3.07	2.00	1.65	1.09	1.35	1.20	1.22	1.66	1.24	3.00
28	.....	.....	2.88	1.96	1.51	1.08	.98	1.25	1.31	1.74	1.29	2.85
29	.....	.....	2.78	1.81	1.41	.98	1.45	1.26	1.35	1.75	1.38	2.61
30	.....	.....	2.61	2.00	1.45	.94	1.05	1.20	1.19	1.61	1.31	2.59
31	.....	.....	2.58	.....	1.52	.....	.96	1.12	.....	1.50	.....	2.60

NOTE.—Gage heights affected by ice Jan. 1 to Mar. 5 and Dec. 6–31. Gage heights during these periods taken to water surface.

BASINS TRIBUTARY TO LAKE ERIE.

HURON RIVER BASIN.

GENERAL FEATURES.

The drainage basin of Huron River lies in the southeastern part of Michigan. The river rises in several small lakes near Pontiac, in Oakland County, flows southwestward until it enters Washtenaw County, and then turns to the southeast and joins Lake Erie near the mouth of Detroit River. Its length, not following the bends of the river, is about 80 miles, and its total drainage area comprises about 1,060 square miles. The only important tributary is Mill Creek, which enters on the right bank at Dexter, Mich. The greatest length of the drainage basin—about 50 miles—parallels Detroit River at a distance of 25 to 30 miles. This basin is connected with Lake Erie by a long narrow valley averaging not more than 5 miles in width, extending from a point near Ypsilanti southeastward to Lake Erie, a distance of 28 miles. In this stretch a large part of the total fall of the river occurs.

The northern part of the catchment area is rolling and its topography is complex. The stream flows through a series of lakes, and north of Dover the basin is largely composed of lakes and surrounding marshes. In the vicinity of Ann Arbor the topography is very rolling. Below Ypsilanti the country is flat.

The elevation of the sources of the river is about 900 feet above sea level; at Portage Lake, where the river turns and flows southeastward, the elevation is 850 feet; at Ypsilanti the elevation is 690 feet; at the mouth of the river it is 573 feet.

There are no forested areas in this section. The mean annual rainfall is about 35 inches. The winters are comparatively mild; the snowfall is not heavy and ice does not form very thick.

Storage problems have not been studied, but the numerous lakes and swamps afford a natural storage and produce a steady flow.

The conditions for water power on this stream are nearly ideal, as almost the entire catchment area is situated above the portion of the river that is best suited for the location of dams. A few sites below Ann Arbor have been developed, and opportunities for further development exist in this stretch of the river.

HURON RIVER AT DEXTER, MICH.

This station, which is located at the highway bridge at Dexter, Mich., was established September 1, 1904.

Mill Creek enters a short distance above the station.

On March 12, 1908, the staff gage which was in use until that time was carried out by the ice; a chain gage was installed March 26, 1908, at the same datum as the staff gage. As the current is swift at the

section, little ice forms and the gage heights are only slightly affected thereby. The datum of the gage has remained unchanged. The high water that carried away the gage produced a permanent change in the bed of the river and altered the relation between the gage heights and discharge which existed prior to March 12, 1908.

A small headrace runs to an abandoned mill on the left bank, but at ordinary and low stages there is little or no flow in this canal; at high stages a small amount of water may pass around the gage through this raceway.

The salary of the gage reader at this station is paid by the Washtenaw Light & Power Co., Ann Arbor.

The discharge measurements taken at this station plot very erratically, and any estimates of discharge attempted on the basis of the records which follow should be used with great caution. This station was last inspected October 16, 1909.

Daily gage height, in feet, of Huron River at Dexter, Mich., for 1910.

[Elisha White, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.75	0.55	2.25	0.50	1.45	0.30	−0.30	−0.30	−0.35	−0.20	−0.15	0.05
2	.35	.50	2.60	.45	1.80	.35	− .30	− .32	− .35	− .20	− .15	.05
3	.35	.50	2.60	.40	2.50	.70	− .30	− .35	− .35	− .20	− .10	.05
4	.82	.50	2.60	.35	2.35	.70	− .30	− .35	− .32	− .20	− .10	.00
5	.80	.50	2.70	.35	2.05	.70	− .30	− .35	− .20	− .20	− .10	.00
6	.80	.50	2.80	.35	1.90	.70	− .30	− .35	− .15	− .10	− .10	.00
7	.75	.80	2.80	.35	1.72	.70	− .30	− .35	− .10	− .05	− .10	.00
8	.68	.75	2.78	.35	1.70	.70	− .30	− .35	− .15	− .05	− .10	.00
9	.65	.58	2.65	.35	1.58	.68	− .32	− .35	− .20	− .10	− .10	.05
10	.80	.50	2.50	.35	1.45	.58	− .35	− .35	− .20	− .10	− .10	.05
11	.70	.50	2.40	.30	1.28	.50	− .35	− .35	− .20	− .10	− .05	.22
12	.40	.50	2.22	.30	1.12	.50	− .25	− .35	− .20	− .12	− .05	.20
13	.40	.50	2.15	.22	.98	.45	− .25	− .40	− .22	− .15	− .05	.20
14	.40	.50	1.95	.20	.88	.38	− .30	− .40	− .25	− .15	− .05	.20
15	.32	.45	1.75	.20	.78	.30	− .30	− .40	− .25	− .15	− .05	.20
16	.20	.40	1.55	.15	.68	.25	− .32	− .35	− .25	− .20	− .05	.20
17	.20	.40	1.42	.15	.60	.20	− .35	− .30	− .25	− .20	− .05	.20
18	.45	.60	1.30	.18	.55	.15	− .35	− .30	− .25	− .20	− .05	.20
19	.50	.60	1.20	.25	.48	.10	− .38	− .35	− .25	− .20	− .05	.20
20	.50	.58	1.20	.30	.45	.10	− .40	− .35	− .25	− .20	− .05	.20
21	.50	.50	1.18	.30	.42	.10	− .40	− .35	− .28	− .20	− .10	.30
22	.70	.45	1.10	.30	.40	.00	− .40	− .35	− .30	− .18	− .10	.20
23	.70	.45	1.05	.30	.40	.00	− .40	− .35	− .30	− .15	− .10	.05
24	.65	.50	1.00	.32	.58	− .05	− .35	− .35	− .15	− .15	− .10	.00
25	.62	.50	.92	.55	.50	− .10	− .30	− .35	− .15	− .15	− .05	.25
26	.55	.55	.85	1.08	.48	− .18	− .30	− .30	− .15	− .15	− .05	.30
27	.55	1.35	.78	1.45	.45	− .25	− .30	− .30	− .15	− .15	.05	.28
28	.55	1.80	.70	1.48	.40	− .25	− .30	− .35	− .15	− .15	.10	.15
29	.55	.....	.65	1.35	.38	− .28	− .30	− .35	− .15	− .15	.10	.00
30	.55	.....	.58	1.30	.30	− .30	− .30	− .35	− .15	− .15	.10	.00
31	.55	.....	.50	.....	.30	.....	− .30	− .35	.....	− .15	.....	.00

HURON RIVER AT GEDDES, MICH.

This station, which is located at the power plant of the Washtenaw Light & Power Co. at Geddes, Mich., was established February 1, 1904.

Fleming Creek enters from the north about half a mile below the station.

The flow of the river at this point is determined by computing the flow through the turbines by knowing the head-gate opening, rating of the wheels, and the number of hours the turbines are run. The flow over the crest of the dam is determined by considering the dam as a weir, the proper coefficient to be applied being assumed.

The records at this station are furnished by the Washtenaw Light & Power Co., of Ann Arbor, Mich. The computations of the discharge are furnished by Gardner S. Williams.

Daily discharge, in second-feet, of Huron River at Geddes, Mich., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,087	537	887	413	.....	.....	.....	164	160	220
2	1,105	489	1,191	407	.....	.....	.....	146	148	191
3	1,337	239	1,755	618	.....	.....	.....	126	164	208
4	1,378	442	1,417	600	.....	.....	.....	149	150	186
5	1,320	464	1,154	582	.....	.....	.....	161	151	178
6	1,295	508	1,043	632	.....	.....	.....	151	158	202
7	1,220	500	1,382	647	.....	.....	.....	166	130	202
8	1,156	462	1,045	620	.....	.....	.....	197	150	165
9	1,031	496	1,057	550	.....	.....	.....	179	168	176
10	1,038	278	955	548	.....	.....	.....	156	175	164
11	941	440	848	546	.....	.....	.....	215	165	190
12	919	387	796	436	.....	.....	.....	166	208	191
13	852	358	735	440	.....	.....	.....	168	129	180
14	852	344	719	440	.....	.....	.....	229	190	184
15	728	353	682	416	.....	.....	.....	143	168	201
16	647	368	626	406	.....	.....	.....	166	173	160
17	626	356	578	386	.....	.....	.....	141	175	181
18	626	360	561	356	.....	.....	.....	152	151	165
19	636	409	518	264	.....	.....	.....	149	167	173
20	692	385	483	318	.....	.....	.....	148	190	171
21	709	470	478	352	.....	.....	.....	150	164	108
22	639	421	507	307	.....	.....	.....	169	189	180
23	558	476	497	270	.....	.....	.....	172	168	166
24	535	510	511	196	.....	.....	.....	144	178	172
25	535	546	510	195	.....	.....	.....	140	189	185
26	512	761	528	174	.....	.....	.....	151	182	130
27	613	941	468	160	.....	.....	.....	157	208	165
28	569	858	457	116	.....	.....	.....	156	211	177
29	519	813	486	68	.....	.....	.....	155	236	190
30	511	668	390	69	.....	.....	.....	179	226	187
31	506	.....	465	.....	.....	.....	.....	117	.....	179

Monthly discharge of Huron River at Geddes, Mich., for 1910.

[Drainage area, 757 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
January	.....	.....	[a] 468	0.618	0.71
February	.....	.....	[a] 496	.655	.68
March	1,378	506	829	1.10	1.27
April	941	239	488	.645	.72
May	1,755	390	765	1.01	1.16
June	647	68	384	.507	.57
July	.....	.....	[a] 123	.162	.19
August	.....	.....	[a] 106	.140	.16
September	.....	.....	[a] 152	.201	.22
October	229	117	160	.211	.24
November	236	129	174	.230	.26
December	220	108	178	.235	.27
The year	.....	.....	360	.476	6.45

[a] Estimated from discharge records at Superior dam, about 1½ miles below Geddes.

HURON RIVER AT FLAT ROCK, MICH.

This station, which is located at the highway bridge at Flat Rock, Mich., about half a mile below the crossing of the Detroit, Toledo & Ironton Railroad, was established August 6, 1904.

No important tributaries enter near the station.

The staff gage is located at the measuring section. The datum of the gage has remained unchanged.

The ordinary flow of the stream is controlled by a dam and power plant immediately above the station, but the operation of this plant is assumed to have but little effect on the diurnal fluctuation of stage. The nearness of the mill prevents the formation of ice in winter at the gaging section, but jams frequently form below the station, causing backwater.

All discharge measurements are made from the bridge.

The salary of the gage reader at this station is paid by the Washtenaw Light & Power Co., Ann Arbor, Mich. This station was last inspected October 16, 1908. The accuracy of the daily and monthly discharges therefore depends on the permanency of conditions of flow and of the elevation of the gage since that date. Conditions of flow are believed to be permanent.

Daily gage height, in feet, of Huron River at Flat Rock, Mich., for 1910.

[C. L. Metler, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.8	3.4	6.4	2.9	4.45	2.45	0.95	0.6	0.55	0.95	0.9	1.35
2	2.65	3.25	7.1	2.8	5.35	2.45	.8	.55	.6	.95	.85	1.25
3	2.55	3.3	7.85	2.5	6.8	2.4	.8	.6	.55	1.0	.95	1.2
4	2.8	3.45	8.5	2.35	7.5	3.35	.8	.65	.9	1.0	.9	1.2
5	2.75	3.3	8.75	2.85	7.1	3.45	.75	.65	.9	1.05	.9	1.2
6	2.55	.....	8.4	2.7	6.35	3.4	.9	.7	.65	.95	.9	1.2
7	2.55	3.0	7.7	2.7	6.6	3.5	.8	.7	.75	.95	.9	1.3
8	2.3	2.95	7.45	2.6	5.2	3.3	.65	.75	1.0	.95	1.3	1.15
9	2.4	2.9	7.05	2.55	4.95	3.2	.65	.7	.95	.95	1.05	1.35
10	2.3	2.95	6.75	2.4	4.95	3.0	.7	.7	1.0	.95	.9	1.1
11	2.55	2.85	6.5	2.15	4.65	2.9	.8	.6	.9	1.05	1.1	1.2
12	2.4	2.65	6.25	2.4	4.45	2.85	.55	.7	.9	.85	1.15	1.1
13	2.35	2.55	6.05	2.0	4.15	2.45	.95	.65	.85	.95	.95	1.35
14	2.55	2.5	5.8	1.95	3.85	2.55	.75	.6	.6	.9	1.0	1.15
15	2.55	2.55	5.55	1.9	3.6	2.3	.75	.55	.8	.85	1.05	1.05
16	2.5	3.1	5.2	1.85	3.35	2.15	.75	.7	.75	.95	1.1	1.05
17	2.3	3.2	4.9	1.95	3.4	2.15	.8	1.0	.75	1.0	1.15	1.75
18	2.9	3.1	4.7	1.8	3.1	2.1	.7	.7	.95	1.0	1.05	1.2
19	3.05	2.85	4.35	2.3	2.95	1.75	.7	.65	.8	.9	.95	1.2
20	3.2	2.8	4.3	3.35	2.8	1.25	.75	.7	.85	.95	1.0	1.25
21	3.35	2.8	4.35	2.55	2.8	1.75	.7	.65	.75	.9	1.05	1.25
22	4.35	2.85	4.55	2.85	2.75	1.5	.7	.6	.....	1.05	1.0	1.4
23	3.6	2.75	4.3	2.7	2.75	1.35	.7	.65	.....	1.0	1.0	1.45
24	3.5	2.75	4.05	2.55	3.2	1.2	.65	.55	.9	1.05	.....	1.50
25	3.55	2.75	3.95	2.55	2.95	.95	.6	.6	.95	.95	1.15	1.65
26	3.5	2.6	3.8	3.75	2.95	.9	.5	.5	1.0	.85	1.05	1.85
27	3.6	3.7	3.4	4.6	2.65	.85	.7	.5	1.15	.95	1.15	1.4
28	3.65	5.3	3.3	5.3	2.55	.95	.6	.65	.85	1.0	1.2	1.35
29	3.6	.....	3.4	5.05	2.45	1.05	.7	.85	.95	1.05	1.25	1.4
30	3.5	.....	3.15	4.6	2.3	.9	.6	.65	.9	.9	1.4	1.3
31	3.45	.....	3.1	.....	2.35	.....	.7	.7	.....	.9	.....	1.35

NOTE.—Gage heights may have been affected by back water from ice jams at times during January, February, March, and December.

Daily discharge, in second-feet, of Huron River at Flat Rock, Mich., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	668	849	1,870	697	1,190	570	220	157	148	220	211	302
2	625	802	2,120	668	1,500	570	192	148	157	220	202	280
3	597	818	2,420	583	2,010	556	192	157	148	230	220	270
4	668	864	2,680	542	2,280	834	192	166	211	230	211	270
5	655	818	2,780	682	2,120	864	183	166	211	240	211	270
6	597	772	2,640	639	1,850	849	211	174	166	220	211	270
7	597	727	2,360	639	1,940	880	192	174	183	220	211	291
8	529	712	2,260	611	1,450	818	166	183	230	220	291	260
9	556	697	2,100	597	1,360	787	166	174	220	220	240	302
10	529	712	1,990	556	1,360	727	174	174	230	220	211	250
11	597	682	1,900	490	1,260	697	192	157	211	240	250	270
12	556	625	1,820	556	1,190	682	148	174	211	202	260	250
13	542	597	1,750	452	1,090	570	220	166	202	220	220	302
14	597	583	1,660	440	991	597	183	157	157	211	230	260
15	597	597	1,570	427	911	529	183	148	192	202	240	240
16	583	757	1,450	415	834	490	183	174	183	220	250	240
17	529	787	1,340	440	849	490	192	230	183	230	260	391
18	697	757	1,280	403	757	477	174	174	220	230	240	270
19	742	682	1,160	529	712	391	174	166	192	211	220	270
20	787	668	1,140	834	668	280	183	174	202	220	230	280
21	834	668	1,160	597	668	391	174	166	183	211	240	280
22	1,160	682	1,220	682	654	334	174	157	192	240	230	312
23	911	655	1,140	639	654	302	174	166	201	230	230	323
24	880	655	1,060	597	787	270	166	148	211	240	245	334
25	896	655	1,020	597	712	220	157	157	220	220	260	368
26	880	611	975	959	712	211	140	140	230	202	240	415
27	911	943	849	1,240	625	202	174	140	260	220	260	312
28	927	1,480	818	1,480	597	220	157	166	202	230	270	302
29	911	.....	849	1,400	570	240	174	202	220	240	280	312
30	880	.....	772	1,240	529	211	157	166	211	211	312	291
31	864	.....	757	.....	542	.....	174	174	.....	211	.....	302

NOTE.—Daily discharge determined from a discharge-rating curve fairly well defined.
Discharge as determined may be too high at times during January, February, March, and December on account of possible ice jams.

Monthly discharge of Huron River at Flat Rock, Mich., for 1910.

[Drainage area, 1,000 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	1,160	529	719	0.719	0.83	D.
February	1,480	583	745	.745	.78	D.
March	2,780	757	1,580	1.58	1.82	C.
April	1,480	403	688	.688	.77	B.
May	2,280	529	1,080	1.08	1.24	B.
June	880	202	509	.509	.57	B.
July	220	140	179	.179	.21	B.
August	230	140	167	.167	.19	B.
September	260	148	200	.200	.22	B.
October	240	202	222	.222	.26	B.
November	312	202	240	.240	.27	B.
December	415	240	293	.293	.34	C.
The year	2,780	140	551	.551	7.50	

NOTE.—Accuracy for January, February, March, and December reduced on account of the possibility of ice effect.

CATTARAUGUS CREEK BASIN.

GENERAL FEATURES.

Cattaraugus Creek rises in the southwestern part of Wyoming County, flows westward, and enters Lake Erie about 25 miles southwest of Buffalo, on the boundary line between Erie and Chautauqua counties. The stream is about 55 miles long and drains an area comprising approximately 560 square miles.[1] Through a large part of its course it forms the boundary between Erie and Chautauqua counties. Its head waters rise at an elevation of between 1,900 to 2,000 feet.

The drainage basin is hilly, fairly well timbered, and rather narrow. There are few tributary streams, those most important entering the river from the south. South branch of Cattaraugus Creek, the largest tributary, enters at a point about 2 miles above Gowanda. There is a dam at Gowanda which is used for developing electric power and also for running a local gristmill and foundry. Formerly there was a dam at Versailles, but it was washed out by a flood a few years ago and at present practically the only power plants on the stream are those at Gowanda.

The average rainfall on the drainage basin is approximately 40 inches.

CATTARAUGUS CREEK AT VERSAILLES, N. Y.

This station, which is located at the highway bridge in the village of Versailles, about 8 miles above the mouth of the stream, 6 miles below Gowanda and 3 miles from Lawton station, on the Erie Railroad, was established September 23, 1910, in cooperation with the New York State Water Supply Commission.

A standard chain gage is attached to the upstream side of the bridge over the right-hand channel. The bridge consists of three spans of 117 feet each.

Discharge measurements are made from the downstream side of the bridge.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission.

Discharge measurements of Cattaraugus Creek at Versailles, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 24	C. C. Covert	118	167	5.02	148
Sept. 23	.....do	130	185	5.00	137

[1] From Fifth Ann. Rept. New York State Water Supply Comm.

Daily gage height, in feet, of Cattaraugus Creek at Versailles, N. Y., for 1910.

[James A. Palmer, observer.]

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		5.05	6.45	6.45	16		5.08	6.18	5.45
2		4.95	6.55	6.42	17		5.02	6.10	5.60
3		4.90	6.15	6.15	18		5.05	6.02	5.60
4		5.05	5.78	5.95	19		5.02	5.98	5.82
5		5.01	5.60	5.90	20		5.02	5.90	5.80
6		5.20	5.60	5.68	21		5.00	5.82	5.72
7		6.15	5.70	5.70	22		5.62	5.80	5.62
8		5.55	5.72	5.65	23	5.05	5.75	5.85	5.70
9		5.28	5.78	5.60	24	5.01	5.40	6.68	5.72
10		5.22	7.68	5.72	25	5.09	5.48	6.95	5.70
11		5.18	7.32	5.70	26	5.05	5.85	6.55	5.75
12		5.12	6.48	5.64	27	5.05	5.55	6.22	5.70
13		5.08	6.30	5.55	28	5.05	6.38	6.20	5.70
14		5.08	6.25	5.65	29	5.05	6.30	6.68	6.98
15		5.08	6.22	5.60	30	5.05	6.22	6.40	7.30
					31		6.10		6.42

NOTE.—Gage heights probably somewhat affected by ice during the greater part of December. The ice passed out of the creek Dec. 29.

BASINS TRIBUTARY TO LAKE ONTARIO.

GENESEE RIVER BASIN.

GENERAL FEATURES.

Genesee River rises in Potter County, Pa., 8 or 10 miles south of the New York-Pennsylvania boundary, flows northwestward for about 32 miles, then turns to the northeast and discharges into Lake Ontario, 7 miles north of Rochester. Its entire length, following bends, is about 135 miles, and its drainage area comprises about 2,450 square miles.

In the northern portion of this basin the topography is rolling, with long easy slopes except along the streams, most of which flow in deep ravines hemmed in by steep banks. There is a gradual rise in a general way through the lakes, and in the upper half of the basin the country becomes rough and is broken by ridges whose summits attain elevations of 2,000 to 2,500 feet above sea level.

The mean annual precipitation in the Genesee basin is about 34 inches, ranging from 30 inches in the lower part of the basin to 42 inches in the higher altitudes in the southern part. The winters are rather less severe than in the westerly or northerly parts of New York State, although the rivers are generally frozen over for varying periods of time.

The series of remarkable lakes tributary to the Oswego basin is continued westward into the basin of the Genesee and includes Conesus, Hemlock, Canadice, and Honeoye. These lakes serve as natural reservoirs, and their inlets drain considerable areas at their upper ends. The slopes adjacent to the lakes themselves are narrow and steep and are drained by gullies and torrential brooks. Below the

lakes the area is rolling and the soil is rich and extensively cultivated. The areas and elevations of these lakes are shown in the following table:

Areas and elevations of lakes in the Genesee River basin.[a]

Lake.	Elevation.	Water-surface area.	Drainage area.
	Feet.	*Sq. miles.*	*Sq. miles.*
Hemlock Lake	896	2.8	46.8
Canadice Lake	1,092	.7	12.6
Honeoye Lake	800	2.5	39.6

[a] These lake basins are shown on the Honeoye, Canandaigua, Naples, and Wayland topographic atlas sheets of the United States Geological Survey, from which the areas have been taken, with the exception of those for Hemlock and Canadice lakes, which are from surveys of Rochester water works.

Other excellent storage sites exist in the Genesee basin, and extensive surveys and studies have been made by the State Water Supply Commission of New York, which has suggested a dam at Portage, furnishing a storage capacity of 18,000,000,000 cubic feet, 11,000,000,000 cubic feet of which will be available for commercial purposes. Such a reservoir would materially help to control the floods upon the Genesee, which under the present conditions periodically cause much damage.

In the 39 miles between Belmont, in central Allegany County, and Portage the river falls 253 feet. At Portage there is a total fall of about 300 feet, made up in three portions, and thence nearly to Mount Morris the river flows at the botton of a deep gorge. From Mount Morris to Rochester the valley is broad and open and the stream is bordered by meadows which are subject to overflow. At Rochester there is another abrupt descent in three heavy falls, amounting to about 360 feet within the city, most of which has been developed.

The State has maintained a dam above Rochester for diverting water to the Erie Canal, and in the basin of Black Creek, one of the upper tributaries of the Genesee from the west, are two reservoirs owned by the State, also used for the benefit of the Erie Canal.

Cuba reservoir, on the Genesee-Allegheny divide, receives a drainage from a tributary area of 26.6 square miles, having a storage volume of 454,000,000 cubic feet. The overflow from this reservoir enters Allegheny River, but the storage water may be turned into the summit of the abandoned Genesee Valley canal and thence into Genesee River.

In the improved barge canal, now under construction, the water supply for this section is to be taken from Lake Erie, and it is probable that no diversion for this purpose will be necessary from the Genesee drainage basin.

GENESEE RIVER AT ST. HELENA, N. Y.

This station, which is located at the steel highway bridge, about 6 miles, by river, below Genesee Lower Falls, 4 miles from Castile, and 5½ miles from Portageville, was established August 14, 1908, in cooperation with the State Water Supply Commission of New York.

The bed of the stream at this point is of coarse gravel with few rocks, and is fairly permanent. There are two channels at low stages and three during high water.

The datum of the chain gage attached to the bridge has remained the same during the maintenance of the station. Two gage readings are made each day.

Discharge measurements are made from the highway bridge or by wading.

There has recently been constructed at this station a concrete well and shelter which contain a self-recording gage. The gage house is located on the downstream side, left-hand end of the bridge. A 4-inch cast-iron water pipe leads to a point in the river channel near the present chain gage. The gage heights here published are taken from the chain gage.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Genesee River at St. Helena, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 21	C. C. Covert	296	889	4.92	3,380
July 19	W. G. Hoyt	103	203	2.06	226
Aug. 26	C. C. Covert	102	168	1.92	159
Oct. 24[a]	W. G. Hoyt	133	150	2.14	214
Nov. 17	do	176	392	3.24	1,010
Dec. 9[b]	do	194	298	2.85	645

[a] Measurement made at wading section above bridge.
[b] Measurement made under partial ice cover; considerable slush ice running; no great backwater effect.

Daily gage heights, in feet, of Genesee River at St. Helena, N. Y., for 1910.

[Herman Piper, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.28	2.85	9.27	3.31	4.90	2.85	2.01	1.78	1.85	2.12	2.58	3.55
2	2.25	2.72	8.82	3.14	6.80	2.78	1.88	1.90	2.12	2.02	2.50	3.55
3	2.60	2.95	8.22	2.98	6.65	2.81	1.68	1.88	2.12	1.95	2.45	3.42
4	2.85	2.72	7.22	3.11	6.75	2.71	1.73	1.82	2.15	2.08	2.60	3.38
5	2.68	2.78	6.77	3.08	5.35	2.75	1.95	1.82	2.08	1.98	2.30	3.30
6	2.88	2.65	7.12	2.98	4.72	2.73	1.95	1.78	2.52	2.02	2.20	3.08
7	2.95	2.60	9.42	2.88	4.25	2.73	1.75	1.55	2.85	2.25	2.32	2.98
8	2.92	2.78	6.27	2.78	3.95	2.68	1.75	1.55	2.70	2.38	2.30	2.90
9	2.82	2.75	5.52	2.84	3.78	2.65	1.91	1.80	2.42	2.25	2.32	2.82
10	2.98	2.68	4.85	2.74	3.68	2.61	1.91	1.95	2.28	2.18	3.0	2.82
11	2.88	2.62	4.62	2.71	3.50	2.61	1.91	2.15	2.12	2.15	3.95	2.92
12	2.78	2.45	4.55	2.58	3.35	2.65	1.85	2.02	2.05	2.02	3.48	2.85
13	2.75	4.25	4.82	2.54	3.22	2.55	2.25	1.70	2.15	1.60	3.50	2.68
14	2.72	4.05	4.29	2.48	3.08	2.45	2.83	1.70	2.12	1.75	3.22	2.72
15	2.85	3.92	4.02	2.51	2.98	2.35	2.48	1.90	1.95	2.00	3.32	2.65
16	2.72	3.89	3.92	2.54	2.88	2.51	2.28	1.95	2.08	1.75	3.25	2.58
17	2.75	4.47	3.77	2.64	2.88	2.55	2.25	1.62	1.92	1.95	3.28	2.65
18	3.10	4.07	3.57	3.44	2.78	2.45	2.15	1.72	1.65	1.95	3.15	2.68
19	4.40	3.77	3.75	4.36	2.85	2.41	2.04	2.05	1.92	1.88	3.10	2.78
20	4.25	3.59	5.56	4.76	2.68	2.35	2.45	2.02	1.92	1.95	3.00	2.78
21	4.20	3.62	5.71	4.83	2.75	2.31	1.80	1.70	1.88	2.10	2.92	2.65
22	6.88	3.57	5.18	4.60	2.62	2.28	1.72	1.90	1.82	1.88	2.82	2.48
23	5.45	3.82	5.31	3.90	2.65	2.25	1.72	1.80	1.75	1.82	2.92	2.58
24	4.70	3.52	5.24	6.60	2.88	2.15	1.65	1.88	1.85	2.10	3.00	2.55
25	4.45	6.42	5.31	8.40	2.92	2.03	2.00	1.58	1.95	2.05	4.08	2.60
26	3.80	6.85	4.76	9.30	3.08	2.05	2.02	1.92	1.92	2.18	4.08	2.52
27	3.75	6.69	4.28	6.88	2.95	2.11	1.70	1.65	2.75	2.45	3.65	2.58
28	3.48	7.72	3.98	5.45	2.82	2.01	1.88	1.52	2.48	2.48	3.38	2.62
29	3.25	.....	3.81	5.85	2.68	1.98	1.90	1.80	2.35	2.72	3.40	2.78
30	3.12	.....	3.46	6.10	2.78	1.95	1.82	1.68	2.25	2.52	4.10	7.80
31	3.02	.....	3.44	.....	2.95	.....	1.65	1.80	.....	2.62	.....	5.05

NOTE.—Relation of gage height to discharge probably affected by the presence of ice from Jan. 1 to 18, Feb. 5 to 27, and Dec. 10 to 31. Gage heights during these periods were taken to water surface.

Daily discharge, in second-feet, of Genesee River at St. Helena, N. Y., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	150	672	19,500	1,070	3,390	672	187	121	140	226	470	1,290
2	150	568	17,000	919	8,340	614	148	154	226	191	420	1,290
3	150	756	14,000	783	7,880	638	98	148	226	169	391	1,170
4	150	568	9,730	894	8,180	560	109	132	239	211	482	1,130
5	150	500	8,250	868	4,360	591	169	132	211	178	308	1,060
6	150	450	9,380	783	3,030	575	169	121	432	191	260	868
7	150	450	20,300	698	2,210	575	114	73	672	284	319	783
8	150	400	6,740	614	1,780	538	114	73	552	351	308	715
9	150	400	4,750	664	1,560	517	157	126	374	284	319	647
10	150	400	3,290	583	1,440	489	157	169	298	252	800	600
11	150	350	2,840	560	1,240	489	157	239	226	239	1,780	550
12	150	350	2,710	470	1,100	517	140	191	201	191	1,220	500
13	150	350	3,230	445	988	451	284	102	239	80	1,240	450
14	150	400	2,270	408	868	391	656	102	226	114	988	400
15	150	400	1,870	426	783	335	408	154	169	184	1,080	350
16	150	400	1,740	445	698	426	298	169	211	114	1,020	300
17	150	350	1,540	510	698	451	284	84	160	169	1,040	300
18	150	350	1,310	1,190	614	391	239	107	91	169	928	250
19	2,450	350	1,520	2,390	672	368	198	201	160	148	885	250
20	2,210	400	4,840	3,110	538	335	391	191	160	169	800	200
21	2,130	400	5,220	3,250	591	313	126	102	148	218	732	200
22	8,600	400	3,980	2,800	496	298	107	154	132	148	647	200
23	4,580	350	4,260	1,710	517	284	107	126	114	132	732	200
24	2,990	300	4,110	7,720	698	239	91	148	140	218	800	200
25	2,540	300	4,260	14,900	732	194	184	77	169	201	1,950	200
26	1,580	300	3,110	19,700	868	201	191	160	160	252	1,950	200
27	1,520	2,000	2,260	8,600	758	222	102	91	591	391	1,400	200
28	1,220	11,700	1,810	4,580	647	187	148	69	408	408	1,130	200
29	1,020	.....	1,590	5,580	538	178	154	126	335	568	1,150	400
30	902	.....	1,200	6,260	614	169	132	98	284	432	1,980	6,000
31	817	.....	1,190	.....	758	.....	91	126	.....	496	.....	3,000

NOTE.—Daily discharge determined from a well-defined discharge rating curve. Discharge for the periods during which ice was present, Jan. 1 to 18, Feb. 5 to 27, and Dec. 10 to 31, approximately determined from climatological records and the discharge at Rochester.

It should be noted that the determination of the daily discharge for Jan. 1 to 18, Feb. 5 to 27, and Dec. 10 to 31 have been revised and supersede those previously published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor, State of New York.

Monthly discharge of Genesee River at St. Helena, N. Y., for 1910.

[Drainage area, 1,030 square miles.]

Month.	Discharge in second-feet.				Run off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	8,600	.....	1,140	1.11	1.28	C.
February	11,700	.....	880	.854	.89	D.
March	20,300	1,190	5,480	5.32	6.13	A.
April	19,700	408	3,100	3.01	3.36	A.
May	8,340	496	1,860	1.81	2.09	A.
June	672	169	407	.395	.44	B.
July	656	91	191	.185	.21	B.
August	239	69	131	.127	.15	B.
September	672	91	256	.249	.28	B.
October	568	80	238	.231	.27	B.
November	1,980	260	918	.891	.99	A.
December	.....	.....	778	.763	.88	C.
The year	20,300	69	1,280	1.24	16.97	

NOTE.—The computations for January, February, December, and the year have been revised and supersede those previously published in the sixth annual report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor, State of New York.

GENESEE RIVER AT JONES BRIDGE, NEAR MOUNT MORRIS, N. Y.

This station, which is at the highway bridge known as Jones Bridge, about 5 miles below Mount Morris, and a short distance below the inflow of Canaseraga Creek, was established May 22, 1903, was discontinued April 30, 1906, and reestablished August 12, 1908, in cooperation with the State Water Supply Commission of New York.

The bed is of sandy clay, and probably subject to change at times. The stream flows in one channel at low stages and two channels at high. The current is good at medium and high stages, but poor at low stages.

The datum of the chain gage attached to the bridge has remained permanent during the maintenance of the station.

Discharge measurements are made from a foot bridge erected on the outriggers of the downstream side of the bridge or by wading.

Conditions for making discharge measurements are favorable and a fairly good rating curve has been developed.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Genesee River at Jones Bridge, near Mount Morris, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 20	C. C. Covert	153	852	9.38	3,700
21	do	145	677	8.70	2,770
July 20	W. G. Hoyt	75	205	4.08	323
Aug. 22[a]	C. C. Covert	48	45.6	3.35	103
Oct. 25	W. G. Hoyt	70	193	3.96	244
Nov. 18	do	91	333	5.58	968

[a] Measurement made at wading section.

Daily gage height, in feet, of Genesee River at Jones Bridge, near Mount Morris, N. Y., for 1910.

[Elizabeth Trewer, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.45	8.05	27.85	6.20	12.90	5.50	3.65	3.60	3.70	4.00	4.70	6.85
2	4.50	7.70	27.70	5.95	16.10	5.25	3.45	3.65	3.85	4.05	4.60	6.40
3	5.00	8.20	27.40	5.75	18.15	5.20	3.45	3.65	3.90	3.90	4.50	6.10
4	5.40	8.85	25.95	5.70	21.10	5.05	3.45	3.60	4.00	3.90	4.65	5.95
5	5.35	7.55	24.05	5.70	15.80	5.00	3.65	3.55	4.05	3.70	4.45	6.00
6	5.30	7.45	23.20	5.65	11.75	5.05	3.55	3.55	4.75	3.90	4.25	5.25
7	5.25	7.00	25.75	5.45	9.55	5.10	3.70	3.35	5.10	4.20	4.25	5.35
8	5.35	6.90	23.70	5.30	8.40	5.10	3.60	3.40	4.90	4.45	4.30	5.60
9	5.30	7.30	18.40	5.15	8.35	5.00	3.60	3.45	4.55	4.20	4.30	6.05
10	5.30	7.15	17.85	5.00	7.45	4.90	3.10	3.55	4.25	4.15	4.70	6.05
11	5.30	6.85	11.25	5.15	7.05	4.80	3.50	3.85	3.95	4.10	6.60	7.70
12	5.30	6.95	10.00	5.15	6.45	4.85	3.50	3.90	3.95	4.05	6.40	7.70
13	5.30	6.90	9.40	5.05	6.25	4.80	3.65	3.60	4.00	4.00	5.70	7.65
14	5.30	6.80	8.75	4.90	6.05	4.60	4.75	3.70	4.00	3.95	5.70	7.40
15	5.30	6.80	8.35	4.80	5.75	4.50	4.70	3.45	3.75	3.70	5.70	7.35
16	5.30	6.70	7.80	4.80	5.60	4.60	4.45	3.70	4.00	3.25	5.70	7.10
17	5.25	7.20	7.50	4.90	5.50	4.56	4.20	3.45	4.00	3.45	5.70	6.35
18	5.25	9.25	7.10	5.75	5.35	4.40	4.15	3.30	3.40	3.85	5.60	.....
19	6.95	9.90	7.00	7.80	5.20	4.40	4.10	3.75	3.90	3.60	5.40	.....
20	9.85	9.70	10.45	8.75	5.10	4.55	4.00	3.95	3.90	3.70	5.40	.....
21	10.95	9.70	13.45	9.25	5.20	4.50	3.70	3.85	3.75	3.55	5.25	.....
22	19.25	9.70	11.45	9.80	5.20	4.35	3.80	3.40	3.75	3.55	5.20	.....
23	19.55	9.70	11.40	8.05	5.15	4.20	3.60	3.60	3.60	3.25	5.10	.....
24	15.75	9.70	10.70	11.20	5.20	4.10	3.30	3.55	3.50	3.60	5.05	6.40
25	12.55	9.70	10.95	22.25	5.55	3.90	3.60	3.55	3.20	3.90	6.85	.....
26	11.15	9.50	10.25	24.65	5.65	3.80	.....	3.75	3.80	4.05	7.35	.....
27	10.45	8.55	8.75	24.45	5.55	3.90	.....	3.60	3.90	4.50	6.55	.....
28	9.75	15.45	7.85	18.50	5.35	3.95	3.80	3.60	4.50	4.40	6.00	.....
29	8.90	.....	7.15	13.40	5.15	3.95	3.60	3.20	4.25	4.60	7.25	.....
30	8.50	.....	6.70	17.65	5.10	3.85	3.65	3.60	4.20	4.80	7.70	13.0
31	8.25	.....	6.35	.....	5.15	.....	3.10	3.80	.....	4.70	.....	.....

NOTE.—More or less backwater caused by ice probably existed at this station from Jan. 1 to Feb. 27 and from Dec. 4 to 31. Gage heights taken to water surface except those for Dec. 13 to 31, which were to the top of the ice.

Daily discharge, in second-feet, of Genesee River at Jones Bridge, near Mount Morris, N. Y., for 1910.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	17,800	1,340	5,880	960	190	175	205	300	575	1,700
2	.....	17,700	1,200	8,440	835	138	190	250	318	530	1,450
3	.....	17,500	1,090	10,100	810	138	190	265	265	490	1,280
4	.....	16,300	1,060	12,400	735	138	175	300	265	552	.....
5	.....	14,800	1,060	8,200	710	190	162	318	205	470	.....
6	.....	14,100	1,040	4,980	735	162	162	598	265	390	.....
7	.....	16,200	935	3,440	760	205	112	760	370	390	.....
8	.....	14,500	860	2,660	760	175	125	665	470	410	.....
9	.....	10,300	785	2,630	710	175	138	510	370	410	.....
10	.....	9,840	710	2,060	665	60	162	390	352	575	.....
11	.....	4,620	785	1,820	620	150	250	282	335	1,560	.....
12	.....	3,750	785	1,480	642	150	265	282	318	1,450	.....
13	.....	3,330	735	1,370	620	190	175	300	300	1,060	.....
14	.....	2,890	665	1,260	530	598	205	300	282	1,060	.....
15	.....	2,630	620	1,090	490	575	138	220	205	1,060	.....
16	.....	2,270	620	1,010	530	470	205	300	90	1,060	.....
17	.....	2,090	665	960	510	370	138	300	138	1,060	.....
18	.....	1,850	1,090	885	450	352	109	125	250	1,010	.....
19	.....	1,790	2,270	810	450	335	220	265	175	910	.....
20	.....	4,060	2,890	760	510	300	282	265	205	910	.....
21	.....	6,320	3,220	810	490	205	250	220	162	835	.....
22	.....	4,760	3,610	810	430	235	125	220	162	810	.....
23	.....	4,730	2,430	785	370	175	175	175	90	760	.....
24	.....	4,240	4,590	810	335	100	162	150	175	735	.....
25	.....	4,420	13,400	985	265	175	162	80	265	1,700	.....
26	.....	3,920	15,300	1,040	235	195	220	235	318	2,000	.....
27	.....	2,890	15,100	985	265	215	175	265	490	1,530	.....
28	7,900	2,300	10,400	885	282	235	175	490	450	1,230	.....
29	.....	1,880	6,280	785	282	175	80	390	530	1,940	.....
30	.....	1,620	9,680	760	250	190	175	370	620	2,210	.....
31	.....	1,420	.....	785	.....	60	235	.....	575	.....	.....

NOTE.—Daily discharge determined from a well-defined discharge rating curve. Discharge July 26 and 27 interpolated.

The determinations of daily discharges for January, February, and December 4–31, previously published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor, State of New York, have been revised but are not republished because approximate.

Monthly discharge of Genesee River at Jones Bridge, near Mount Morris, N. Y., for 1910.

[Drainage area, 1,410 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	1,400	0.993	1.14	C.
February	7,900	.....	1,000	.709	.74	C.
March	17,800	1,420	6,990	4.96	5.72	A.
April	15,300	620	3,510	2.49	2.78	A.
May	12,400	760	2,630	1.86	2.14	A.
June	960	235	541	.384	.43	A.
July	598	60	226	.160	.18	B.
August	282	80	178	.126	.15	B.
September	760	80	316	.224	.25	A.
October	620	90	300	.213	.25	A.
November	2,210	390	989	.701	.78	A.
December	.....	.....	900	.638	.74	C.
The year	17,800	60	1,580	1.12	15.30	

NOTE.—Monthly discharge for January, February, and December computed from the discharge at St. Helena and Rochester, with due consideration to the relative drainage areas.

The computations for the winter months and the year have been revised and supersede those previously published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor, State of New York.

GENESEE RIVER NEAR ROCHESTER, N. Y.

This station, which is located at the Elmwood Avenue highway bridge about 3½ miles south of the city of Rochester, at the north end of South Park, was established by the United States Geological Survey February 9, 1904, and has been maintained in cooperation with the Barge canal and the State Water Supply Commission to date.

The bed of the river is composed of gravel and is fairly permanent. The bridge consists of six spans of about 125 feet each.

A staff gage is fastened to the downstream face of the first pier from the right-hand abutment of the bridge. This has been read under the direction of E. A. Fisher, city engineer. During the summer of 1910 a Gurley recording gage was installed in the pump house located at the right-hand end of the bridge and since December, 1910, nearly continuous records have been obtained. The datum for both the staff and recording gages has remained the same; zero of gage 506.848, Barge canal datum.

Discharge measurements are made from the downstream side of the bridge.

Conditions are very favorable for making accurate measurements, although in periods of low water low velocities may affect the accuracy somewhat.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Genesee River near Rochester, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Oct. 22	Hoyt and Shuttleworth	338	1,110	1.07	369
Nov. 18	W. G. Hoyt	248	1,380	1.85	1,320

Daily gage height, in feet, of Genesee River near Rochester, N. Y., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.00	2.00	6.60	2.20	6.00	1.80	1.10	1.00	0.76	1.30	1.20	.....
3	1.00	2.00	7.20	2.20	5.40	1.80	1.10	1.00	1.00	1.30	1.30	2.32
3	1.00	2.00	9.00	2.00	6.60	1.80	1.10	1.00	1.00	1.30	1.30	.....
4	1.00	2.00	10.80	1.90	7.50	1.70	1.10	.95	1.00	1.30	1.30	2.09
5	1.00	2.00	11.00	1.90	7.40	1.70	1.10	.95	1.00	1 30	1.30	2.01
6	1.00	2.00	10.40	1.90	5.40	1.80	1.08	.90	1.60	1.40	1.30	1.90
7	1.00	2.00	9.90	1.80	4.00	1.80	1.05	.90	2.20	1.60	1.30	1.80
8	1.00	1.90	9.60	1.80	3.50	1.80	1.02	.90	2.00	1.60	1.30	1.90
9	1.00	1.90	9.30	1.80	3.10	1.80	1.00	.90	1.50	1.50	1.30	2.10
10	1.00	1.80	8.20	1.80	3.00	1.70	1.00	.90	1.50	1.40	1.30	1.70
11	1.00	1.70	5.70	1.70	2.80	1.70	1.00	1.00	1.40	1.40	1.40	1.70
12	1.00	1.70	4.40	1.70	2.50	1.70	1.00	1.00	1.30	1.20	2.30	1.50
13	1.00	1.70	4.00	1.60	2.50	1.70	.98	1.00	1.20	1.20	2.10	1.56
14	1.00	1.70	3.80	1.60	2.30	1.60	1.00	1.00	1.15	1.20	1.90	1.43
15	1.00	1.70	3.50	1.50	2.10	1.60	1.00	.99	1.10	1.20	1.90	1.42
16	1.00	1.70	3.20	1.50	2.00	1.50	1.30	.98	1.20	1.10	1.90	1.49
17	1.00	1.90	3.00	1.50	2.00	1.50	1.30	1.00	1.10	1.10	1.90	1.52
18	1.20	2.40	2.90	1.70	2.00	1.40	1.10	1.00	1.05	1.10	1.90	1.33
19	1.30	3.00	2.70	1.90	1.90	1.40	1.10	1.00	1.00	1.00	1.90	1.24
20	1.60	3.00	2.70	2.80	1.90	1.40	1.10	1.00	1.02	1.00	1.90	1.32
21	3.60	3.00	5.10	3.50	1.80	1.40	1.10	.98	1.02	1.00	1.80	1.51
22	4.00	3.00	4.80	3.30	1.70	1.30	1.10	.97	1.00	1.00	1.70	1.52
23	5.00	3.00	4.30	3.20	1.60	1.30	1.00	1.00	1.00	1.00	1.60	1.31
24	5.10	3.00	4.20	3.30	1.70	1.30	1.00	1.00	1.00	1.00	1.60	1.24
25	4.00	3.00	4.00	6.80	1.90	1.20	1.10	1.00	1.10	1.10	1.60	1.28
26	3.60	3.00	4.00	7.60	2.00	1.20	1.10	.97	1.10	1.20	2.50	1.35
27	3.20	3.00	3.50	8.20	2.00	1.20	1.10	.95	1.05	1.20	2.60	1.21
28	2.80	3.00	3.00	8.20	2.00	1.10	1.05	.90	1.05	1.20	2.30	1.24
29	2.60	.....	2.70	6.80	1.90	1.10	1.00	.88	1.10	1.20	2.30	1.29
30	2.20	.....	2.50	6.50	1.90	1.10	1.00	.86	1.10	1.20	2.80	1.46
31	2.00	.....	2.30	.....	1.80	.....	1.00	.79	.....	1.20	.....	3.73

NOTE.—Relation of gage height to discharge probably affected by the presence of ice from Feb. 17 to 28 and from Dec. 15 to 30. There was also probably some slight effect from ice during the first part of January and February. Gage heights were probably taken to water surface.

Daily discharge, in second-feet, of Genesee River near Rochester, N. Y., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	320	1,600	13,200	1,960	11,400	1,300	405	320	174	610	500	2,640
2	320	1,600	15,100	1,960	9,620	1,300	405	320	320	610	610	2,180
3	320	1,600	21,400	1,600	13,200	1,300	405	320	320	610	610	1,970
4	320	1,600	28,200	1,450	16,100	1,150	405	285	320	610	610	1,760
5	320	1,600	29,000	1,450	15,800	1,150	405	285	320	610	610	1,620
6	320	1,600	26,600	1,450	9,620	1,300	388	250	1,000	730	610	1,450
7	320	1,600	24,700	1,300	5,800	1,300	362	250	1,960	1,000	610	1,300
8	320	1,450	23,600	1,300	4,600	1,300	337	250	1,600	1,000	610	1,450
9	320	1,450	22,500	1,300	3,720	1,300	320	250	860	860	610	1,780
10	320	1,300	18,500	1,300	3,500	1,150	320	250	860	730	610	1,150
11	320	1,150	10,500	1,150	3,100	1,150	320	320	730	730	730	1,150
12	320	1,150	6,840	1,150	2,500	1,150	320	320	610	500	2,140	860
13	320	1,150	5,800	1,000	2,500	1,150	306	320	500	500	1,780	944
14	320	1,150	5,320	1,000	2,140	1,000	320	320	452	500	1,450	769
15	320	1,150	4,600	860	1,780	1,000	320	313	405	500	1,450	700
16	320	1,150	3,940	860	1,600	860	610	306	500	405	1,450	650
17	320	1,000	3,500	860	1,600	860	610	320	405	405	1,450	600
18	500	900	3,300	1,150	1,600	730	405	320	362	405	1,450	550
19	610	900	2,900	1,450	1,450	730	405	320	320	320	1,450	500
20	1,000	1,000	2,900	3,100	1,450	730	405	320	337	320	1,450	450
21	4,840	1,000	8,780	4,600	1,300	730	405	306	337	320	1,300	450
22	5,800	1,000	7,940	4,160	1,150	610	405	299	320	320	1,150	400
23	8,500	900	6,580	3,940	1,000	610	320	320	320	320	1,000	450
24	8,780	800	6,320	4,160	1,150	610	320	320	320	320	1,000	450
25	5,800	800	5,800	13,900	1,450	500	405	320	405	405	1,000	400
26	4,840	800	5,800	16,400	1,600	500	405	306	405	500	2,500	450
27	3,940	1,500	4,600	18,500	1,600	500	405	285	362	500	2,700	450
28	3,100	2,500	3,500	18,500	1,600	405	362	250	362	500	2,140	450
29	2,700	.....	2,900	13,900	1,450	405	320	238	405	500	2,140	500
30	1,960	.....	2,500	12,900	1,450	405	320	226	405	500	3,100	750
31	1,600	.....	2,140	.....	1,300	.....	320	186	.....	500	.....	5,150

NOTE.—Daily discharge determined from a well-defined discharge rating curve. Discharge for periods during which ice existed, Feb. 17 to 28 and Dec. 15 to 30, determined approximately by means of climatological records.

Determinations of daily discharge for Feb. 17 to 28 and Dec. 15 to 30 have been revised and supersede those previously published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor, State of New York.

Monthly discharge of Genesee River near Rochester, N. Y., for 1910.

[Drainage area, 2,360 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	8,780	320	1,920	.814	.94	B.
February	.....	.....	1,260	.534	.56	C.
March	29,000	2,140	10,600	4.49	5.18	A.
April	18,500	860	4,620	1.96	2.19	A.
May	16,100	1,000	4,130	1.75	2.02	A.
June	1,300	405	906	.384	.43	A.
July	610	320	379	.161	.19	B.
August	320	186	291	.123	.14	B.
September	1,960	174	533	.226	.25	A.
October	1,000	320	537	.228	.26	A.
November	3,100	500	1,290	.547	.61	A.
December	5,150	.....	1,110	.466	.49	B.
The year	29,000	174	2,300	.975	13.26	

NOTE.—The computations for February, December, and the year have been revised and supersede those previously published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor, State of New York.

CANASERAGA CREEK BASIN

GENERAL FEATURES.

Canaseraga Creek, one of the most important tributaries of Genesee River from the east, rises in the extreme northwestern corner of Steuben County and flows northwestward, joining the Genesee a short distance below the village of Mount Morris.

Keshequa Creek, the principal tributary of Canaseraga Creek, rises among the hills of northern Allegany County and flows north and northeast through Nunda and Tuscarora, joining Canaseraga Creek near Sonyea. Throughout its length of some 20 miles it flows through a narrow valley and falls about 1,200 feet. No power is developed, as the flow during the summer averages only 3 to 6 second-feet. The yearly rainfall is a little above the average for the Genesee Valley and ranges from 28 to 36 inches.

Throughout its course Canaseraga Creek winds across a flat, fertile valley devoted almost entirely to agriculture. From the village of Dansville to Mount Morris, a distance of 22½ miles, its velocity is so slow that the large amount of silt brought down from the foothills by the smaller streams is deposited in the creek bed, raising it to an elevation higher, in many places, than the surrounding country. The deposit of silt and the extremely tortuous course of the creek cause the 11,000 acres, which border the stream below Dansville, to become annually inundated by the flood waters. The State Water Supply Commission, acting on the petition of the people residing in the vicinity and under the authority acquired in 1906 when the duties of the River Improvement Commission were transferred to

them, have sold bonds to the extent of $200,000 and work is now being started which is expected to alleviate much of the damage caused by floods.

CANASERAGA CREEK AT DANSVILLE, N. Y.

This station, which is located at the highway bridge 1 mile due west from the village of Dansville and about 22 miles above the mouth of the stream, was established July 21, 1910, in cooperation with the New York State Water Supply Commission.

A staff gage, bolted to the downstream, left-hand wing wall, is read twice daily. The bed of the stream at this point is composed of sand and gravel and may shift during high water.

Low-water measurements are made by wading below the bridge; and high-water measurements will be made from the bridge.

The rating curve is not yet sufficiently developed to warrant publishing the discharge.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Canaseraga Creek at Dansville, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 21[a]	W. G. Hoyt	42	22.7	1.75	27.3
Aug. 21[a]	C. C. Covert	43	29.6	1.72	36.0
Oct. 26[a]	F. J. Shuttleworth	44	22.6	1.80	30.7

[a] Measurement made at wading section.

Daily gage height, in feet, of Canaseraga Creek at Dansville, N. Y., for 1910.

[Floyd Harter, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.75	1.82	1.75	1.78	1.92	16	.....	1.72	1.72	1.70	1.85	.....
2	.....	1.75	1.75	1.70	1.80	1.98	17	.....	1.75	1.75	1.72	1.82	.....
3	.....	1.78	1.88	1.70	1.75	2.08	18	.....	1.78	1.75	1.72	1.82	.....
4	.....	1.78	1.80	1.68	1.80	2.02	19	.....	1.85	1.78	1.68	1.92	.....
5	.....	1.75	1.75	1.68	1.80	2.00	20	.....	1.78	1.75	1.68	1.88	.....
6	.....	1.75	1.85	1.75	1.80	1.92	21	1.75	1.75	1.72	1.72	1.82	.....
7	.....	1.78	1.78	1.95	1.78	1.90	22	1.72	1.75	1.72	1.75	1.80	.....
8	.....	1.75	1.75	1.78	1.78	1.82	23	1.75	1.72	1.72	1.72	1.85	.....
9	.....	1.75	1.78	1.75	1.90	1.88	24	1.78	1.70	1.85	1.75	1.80	.....
10	.....	1.92	1.75	1.75	2.02	1.85	25	1.75	1.72	1.78	1.88	2.08	.....
11	.....	1.82	1.72	1.72	2.15	.....	26	1.75	1.82	1.75	1.82	2.02	.....
12	.....	1.75	1.72	1.75	1.92	.....	27	1.75	1.75	1.75	1.82	1.95	.....
13	.....	1.75	1.72	1.72	1.80	.....	28	1.80	1.75	1.72	1.80	2.05	.....
14	.....	1.75	1.75	1.70	1.82	.....	29	1.75	1.72	1.72	1.82	2.00	.....
15	.....	1.72	1.72	1.72	1.80	.....	30	1.85	1.72	1.75	1.80	1.92	.....
							31	1.75	1.72	.....	1.82	.....	.....

NOTE.—Relation between gage height and discharge affected by presence of ice Dec. 10 to 31.

KESHEQUA CREEK AT SONYEA, N. Y.

This station, which is located at the upper highway bridge in the village of Sonyea, about 2 miles above the mouth of the stream, was established July 22, 1910, in cooperation with the New York State Water Supply Commission.

A staff gage for low-water observations is fastened to a pile on the right-hand bank between the two bridges, directly back and across from the Craig Colony power house. On October 25, a chain gage, for observation at high stages, was installed on the upstream side of the upper bridge.

At ordinary stages discharge measurements are made by wading. During high stages measurements may be made from either bridge.

The bed of the creek is composed of gravel and sand and the channel shifts from year to year. The rating curve is not yet developed.

Information in regard to this station is contained in the annual reports of the State water supply commission and the State engineer and surveyor, State of New York.

Discharge measurements at Keshequa Creek at Sonyea, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.[a]	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 22[b]	W. G. Hoyt	18	6.16	0.55	2.61
Aug. 26[b]	C. C. Covert	8.6	2.6	.52	1.96
Oct. 25[b]	W. G. Hoyt	22	8.6	c.61	4.99

[a] Staff gage. [b] Measurement made at wading section. [c] Chain gage read 3.46.

Daily gage height, in feet, of Keshequa Creek at Sonyea, N. Y., for 1910.

[Elmer E. Reynolds, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	0.55	0.65	0.55	0.65	0.95	16	.....	0.55	0.60	0.55	0.78	.....
2	.....	.62	.60	.55	.65	.85	17	.....	.60	.60	.55	.75	.....
3	.....	.58	.65	.55	.70	.80	18	.....	.62	.60	.55	.75	.....
4	.....	.55	.65	.55	.68	.75	19	.....	.75	.60	.55	.75	.....
5	.....	.55	.68	.55	.65	.80	20	.....	.70	.62	.55	.70	.....
6	.....	.58	.68	.62	.65	.80	21	.....	.62	.65	.55	.75	.....
7	.....	.55	.65	.80	.65	.80	22	0.55	.60	.65	.58	.75	.....
8	.....	.55	.68	.80	.70	.80	23	.58	.60	.65	.60	.70	.....
9	.....	.58	.68	.75	.70	.80	24	.55	.60	.60	.60	.70	.....
10	.....	.62	.60	.68	.80	.....	25	.55	.60	.60	.60	.82	.....
11	.....	.72	.60	.65	.85	.....	26	.58	.58	.60	.60	.85	.....
12	.....	.65	.60	.65	.80	.....	27	.55	.65	.60	.60	.82	.....
13	.....	.62	.62	.65	.80	.....	28	.55	.60	.55	.65	.80	.....
14	.....	.58	.62	.60	.78	.....	29	.55	.60	.55	.65	.88	.....
15	.....	.55	.60	.55	.80	.....	30	.55	.58	.55	.65	.88	.....
							31	.55	.60	.....	.65	.....	.....

NOTE.—Readings discontinued Dec. 10 because of ice. All gage heights refer to staff gage.

CANADICE LAKE OUTLET NEAR HEMLOCK, N. Y.

Canadice Lake is tributary to Genesee River through Hemlock Lake outlet and Honeoye Creek. Hemlock Lake is used as a source

of water supply for the city of Rochester. The gaging station was established at the outlet at the foot of the lake by the city engineer's department of Rochester in February, 1903.

A standard thin-edged weir with a 5-foot crest and two end contractions is so arranged with needle timbers at the ends that during high water the length may be increased to 14.96 feet with no end contractions. The weir crest stands 3 feet above the stream channel and is never submerged by backwater. There are two additional rectangular gates, each 1 foot square, with three complete contractions and a fourth partial contraction at the bottom. The outflow from the lake at the dam above the weir is controlled by gates.

A reading of the depth on the weir is taken each morning and also for each change of the gates, the depth being read to hundredths and corrections being made for velocity of approach for the larger discharges. The discharge is calculated by the Francis formula. The record has been furnished by E. A. Fisher, city engineer, and John F. Skinner, principal assistant city engineer, of Rochester, N. Y.

Information in regard to this station is contained in the reports of the State engineer and surveyor and the city engineer of Rochester.

Monthly discharge of Canadice Lake outlet near Hemlock, N. Y., for 1910.

[Drainage area, 12.6 square miles.]

Month.	Discharge in second-feet.		Run-off (depth in inches on drainage area).	Mean elevation of lake above low-water mark, in feet.
	Mean.	Per square mile.		
January	3.701	0.294	0.34	−1.409
February	4.127	.328	.34	− .768
March	22.975	1.82	2.10	+1.929
April	11.005	.873	.97	2.054
May	24.226	1.92	2.21	2.800
June	5.661	.449	.50	2.473
July	4.570	.363	.42	1.904
August	4.266	.339	.39	1.481
September	4.987	.396	.44	1.330
October	4.796	.381	.44	.927
November	5.933	.471	.53	.539
December	5.831	.463	.53	.523
The year	8.506	.675	9.21	1.148

NOTE.—The figures showing monthly discharge in second-feet per square mile and run-off depth in inches on drainage area do not represent natural flow, as the discharge is controlled through head gates.

OSWEGO RIVER BASIN.

GENERAL FEATURES.

Oswego River is formed by the union of Seneca and Oneida rivers about 12 miles northwest of Syracuse, whence its course is northwestward to Oswego, where it enters Lake Ontario. The length of the

river from the junction to the mouth is about 20.5 miles, and the drainage basin in this district is a narrow strip of moderately rolling country. Above the junction of Seneca and Oneida rivers the basin spreads out, attaining a total width east and west of about 100 miles and north and south of about 80 miles. The total drainage area is about 5,000 square miles.

The rise is, on the whole, gradual from the low level lands which border Lake Ontario to the north-south ridges which separate the various lakes south of Seneca River and which farther south become merged with the still more elevated country lying along the southern boundary of the Lake Ontario drainage basin.

The most remarkable feature of the drainage basin is the chain of lakes stretching across its southern border. From west to east the principal lakes are, in order, Canandaigua, Keuka, Seneca, Cayuga, Owasco, Skaneateles, and Oneida. These seven lakes include a water surface of approximately 280 square miles, increased by four smaller lakes—Cross, Onondaga, Otisco, and Cazenovia—to about 295 square miles. The larger of the lakes—Oneida, Cayuga, and Seneca—are used for steam-towing navigation, having connection with the Erie and Oswego canals. Cayuga and Seneca lakes are noted for their depth and for the abrupt slopes of their beds. The influence of the lakes on Oswego River is of the utmost importance in contributing to the steadiness of its flow.

A fall of 100 feet in the course of the main river is largely utilized by seven dams, which also partly canalize the stream. The intervening stretches are covered by the Oswego Canal, which draws its water supply from the river.

The mean annual precipitation in this basin is about 35 inches, and the winters are rather less severe than farther east and north in the State.

The Oswego and its tributaries are important in connection with the new barge canal. The Oswego itself is to be canalized and serve as a connection from the main canal at Three Rivers to Lake Ontario. The route of the main canal passes through Oneida Lake down Oneida River to its junction with Seneca River at Three River Point, thence up Seneca River in its general westward course. The water supply for the Oswego River section will be furnished from this drainage.

ONEIDA RIVER AT CAUGHDENOY, N. Y.

This station, which takes the place of the station on Oneida River near Euclid, N. Y., is located at Caughdenoy, about 6 miles above the old Euclid Station at Oak Orchard State dam, half a mile below the mouth of Caughdenoy Creek (which enters from the north) and 5 miles below Lake Oneida.

The station is maintained by the State engineer, by whom the following description and records of discharge have been furnished.

A masonry dam was completed across Oneida River at Caughdenoy during the summer of 1909. This dam has a substantially level crest, 415 feet long. The crest is at elevation 369.4 feet and has an ogee cross section with a slope, or batter, on the upstream portion of the crest, of 1 foot rise in 2 feet horizontal width. The downstream portion of the crest is rounded, with a radius of 3.24 feet.

The gage is located about 150 feet upstream from the dam, on the right-hand side of the stream. The channel at this point is about 350 feet wide, the average bottom elevation being 365.0. The discharge from the dam has been calculated from United States Geological Survey experiments on a dam of ogee cross section similar in form, and an allowance has been made for velocity of approach. During the summer, and also to some extent during the winter, water is diverted past the left-hand end of the dam through the Caughdenoy lock. An estimate of the amount of diversion has been made and included in the calculated discharge of the river.

Information in regard to this station is contained in the report of the New York State engineer and surveyor.

Daily discharge, in second-feet, of Oneida River at Caughdenoy, N. Y., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,730	5,122	5,678	4,943	2,102	1,806	862	388	264	.....	289	1,868
2	2,456	5,122	6,900	4,760	2,051	1,596	845	388	388	289	325	1,747
3	2,730	4,760	7,945	4,907	2,127	1,376	810	362	325	442	388	1,747
4	2,730	4,760	8,866	4,907	2,000	1,706	776	388	325	337	528	1,747
5	2,730	4,760	9,112	4,871	1,878	1,878	793	456	388	415	456	1,747
6	2,730	5,122	10,136	4,907	1,878	1,624	706	388	456	617	415	1,696
7	3,089	5,122	10,619	4,604	1,830	1,706	671	325	.....	337	993	1,641
8	2,730	5,122	10,619	4,174	2,000	1,706	635	325	388	428	810	1,696
9	2,730	5,488	10,860	4,041	1,706	1,878	600	337	325	289	1,030	1,477
10	2,730	5,122	10,860	3,653	1,569	2,000	564	289	388	325	810	1,260
11	2,730	5,122	10,860	3,846	1,569	2,127	.....	456	.....	289	845	1,260
12	3,089	5,122	10,860	3,590	1,569	1,951	325	.....	.....	325	899	1,219
13	3,089	5,122	10,860	3,526	1,487	1,830	264	.....	456	315	706	1,302
14	3,089	4,760	10,377	3,309	1,487	1,757	.....	496	456	325	671	1,260
15	3,089	4,376	9,894	3,400	1,487	1,706	456	469	456	325	741	1,219
16	3 089	4,376	9,894	3,526	1,439	1,624	388	415	388	313	1,229	1,219
17	3,089	4,376	9,358	3,278	1,487	1,596	456	337	388	325	1,542	1,159
18	3,400	4,760	9,358	2,942	1,069	1,542	388	313	388	325	1,229	1,159
19	3,089	4,760	9,358	2,647	671	1,439	.....	388	388	313	1,397	1,020
20	3,089	4,760	9,358	2,620	1,376	1,376	388	456	325	325	1,542	1,059
21	3,089	5,122	9,358	2,647	1,229	1,376	388	456	325	242	1,757	1,059
22	4,041	5,122	8,866	2,647	1,149	1,376	362	456	325	289	1,757	1,059
23	4,041	5,122	8,866	2,647	1,878	1,376	456	456	264	.....	1,706	1,179
24	4,376	4,760	8,866	2,647	1,706	1,189	456	442	617	52	1,757	1,139
25	4,376	4,760	8,866	2,620	1,878	1,189	.....	496	374	264	1,706	1,139
26	5,122	4,760	8,866	2,510	1,854	1,069	456	325	337	120	1,757	1,219
27	5,488	4,760	9,358	1,990	1,830	974	362	264	428	161	1,757	1,059
28	5,122	5,488	8,866	1,941	1,878	918	362	264	242	242	1,878	1,099
29	5,122	.....	4,907	1,747	1,951	881	388	325	325	264	1,951	1,099
30	5,122	.....	4,978	1,586	1,878	845	456	388	456	242	1,902	1,302
31	5,122	.....	4,907	.....	1,757	.....	388	388	.....	289	.....	1,344

Monthly discharge, in second-feet, of Oneida River at Caughdenoy, N. Y., for 1910.

[Drainage area, 1,377 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
January	5,488	2,730	3,524	2.559	2.950
February	5,488	4,376	4,747	3.447	3.590
March	10,860	4,907	8,983	6.524	7.521
April	4,943	1,586	3,381	2.455	2.739
May	2,127	671	1,670	1.213	1.399
June	2,127	845	1,514	1.099	1.226
July (27 days)	862	264	519[a]	0.377	[a] 0.435
August (29 days)	496	264	387[a]	0.281	[a] 0.324
September (27 days)	617	242	377[a]	0.274	[a] 0.306
October (29 days)	617	52	304[a]	0.221	[a] 0.255
November	1,951	289	1,159	0.842	0.939
December	1,868	1,020	1,329	0.965	1.112
The year	10,860	52	2,326	1.688	22.160

[a] Computed as if complete months.

SALMON RIVER BASIN.

GENERAL FEATURES.

Salmon River rises in the southwestern part of Lewis County, N. Y., flows southward and then northward, and enters Lake Ontario near Port Ontario. Its drainage area comprises about 285 square miles. The topography is in general rolling, and the soil is sandy, rock lying near the surface in the upper part of the basin, where there are extensive tracts of virgin forest.

The mean annual precipitation is about 35 inches, and during the winter there is usually a heavy fall of snow, which accumulates in the forested areas to a depth of several feet. The gradual melting of this snow in the spring tends to prevent high freshets.

The basin affords several opportunities for storage. At High Falls there is an undeveloped fall of about 110 feet, occurring in a very short distance. Considering its size, this river affords rather important opportunities for the development of power.

SALMON RIVER NEAR PULASKI, N. Y.

This station, which is located at Fox's bridge, the first highway bridge above the village of Pulaski, was established by the United States Geological Survey September 5, 1900, discontinued June 30, 1907, reestablished August 16, 1908, and discontinued December 6, 1908. It was maintained during these periods in cooperation with the State engineer and surveyor. On July 14, 1910, it was reestablished by the Survey in cooperation with the State Water Supply Commission of New York.

A vertical staff gage was attached to the upstream end of the center pier, with its zero 11.59 feet below the bench mark, which is the top of the capstone of the center pier. This gage was removed by ice during the winter of 1901–2 and then replaced July 23, 1902, by a chain gage, having its zero 12.79 feet below the original bench mark. The gage datum has remained permanent since July 23, 1902.

Discharge measurements are made from the bridge or by wading.

The station can be reached by a short drive from either Pulaski or Richland. Conditions are poor for records during the winter, when the channel usually becomes clogged by ice. The open-channel rating curve is fairly good.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Salmon River near Pulaski, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 13	W. G. Hoyt	168	239	2.61	168
Aug. 25	do	169	234	2.61	[a] 181

[a] Measurement made at wading section.

Daily gage height, in feet, of Salmon River near Pulaski, N. Y., for 1910.

[Seymour J. Fox, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.50	3.47	2.58	3.10	3.20	16	2.58	2.62	2.60	2.68	3.52	3.00
2	.....	2.50	3.60	2.58	3.10	3.18	17	2.72	2.85	2.65	2.62	3.42	3.30
3	.....	2.62	3.12	2.50	3.70	3.10	18	2.70	2.80	2.50	2.60	3.35	.....
4	.....	2.58	3.75	2.48	3.55	3.10	19	2.50	3.28	2.50	2.60	3.28	.....
5	.....	2.88	3.50	2.92	3.50	3.02	20	2.48	3.38	2.60	2.60	3.25	.....
6	.....	3.50	3.70	4.05	3.42	2.90	21	2.52	2.98	2.50	2.55	3.10	.....
7	.....	3.90	3.72	4.10	3.50	2.90	22	2.50	2.72	2.55	2.55	3.30	.....
8	.....	3.15	3.25	3.65	3.38	2.90	23	2.62	2.75	2.45	2.68	3.28	.....
9	.....	2.90	3.05	3.20	3.38	3.00	24	2.65	2.60	2.50	3.00	3.35	.....
10	.....	2.92	3.00	3.12	3.65	3.00	25	2.55	2.60	2.65	2.98	3.50	.....
11	.....	3.85	2.70	3.00	4.80	3.00	26	2.55	2.75	2.60	3.75	3.48	.....
12	.....	3.62	2.78	3.88	4.30	3.00	27	2.50	2.90	2.68	3.58	3.38	.....
13	.....	3.35	2.60	2.78	4.02	3.10	28	2.60	2.82	2.62	3.52	3.30	.....
14	2.78	2.85	2.62	2.70	3.75	3.05	29	2.55	2.62	2.62	3.52	3.28	.....
15	2.55	2.72	2.70	2.70	3.60	3.00	30	2.50	2.50	2.68	3.38	3.28	.....
							31	2.60	2.65	.....	3.22	.....	.....

NOTE.—Ice present Dec. 9 to 31.

Daily discharge, in second-feet, of Salmon River near Pulaski, N. Y., for 1910.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1	.....	118	666	145	400	465	16	145	160	152	183	707	.....
2	.....	118	775	145	400	452	17	200	260	172	160	626	.....
3	.....	160	413	118	865	400	18	191	235	118	152	572	.....
4	.....	145	912	112	732	400	19	118	521	118	152	521	.....
5	.....	275	690	296	690	352	20	112	595	152	152	500	.....
6	.....	690	865	1,230	626	285	21	125	329	118	135	400	.....
7	.....	1,060	884	1,290	690	285	22	118	200	135	135	535	.....
8	.....	432	500	820	595	285	23	160	213	103	183	521	.....
9	.....	285	370	465	595	.....	24	172	152	118	340	572	.....
10	.....	296	340	413	820	.....	25	135	152	172	329	690	.....
11	.....	1,010	191	340	2,290	.....	26	135	213	152	912	674	.....
12	.....	793	226	1,040	1,540	.....	27	118	285	183	758	595	.....
13	.....	572	152	226	1,190	.....	28	152	245	160	707	535	.....
14	226	260	160	191	912	.....	29	135	160	160	707	521	.....
15	135	200	191	191	775	.....	30	118	118	183	595	521	.....
							31	152	172	.....	479	.....	.....

NOTE.—Daily discharge determined from a fairly well defined discharge rating curve.
The computations have been revised and supersede those previously published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor, State of New York.

Monthly discharge of Salmon River near Pulaski, N. Y., for 1910.

[Drainage area, 259 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
July 14–31	226	112	147	0.568	0.38	B.
August	1,060	118	336	1.30	1.50	B.
September	912	103	318	1.23	1.37	B.
October	1,040	112	423	1.63	1.88	B.
November	2,290	400	720	2.78	3.10	B.
December	.....	.....	335	1.29	1.49	D.

NOTE.—Discharge for the period during which ice existed, Dec. 9 to 31, estimated by means of comparisons with the run-off from adjacent drainages.
Mean discharge Dec. 9 to 31 estimated 324 second-feet.
The computations have been revised and supersede data contained in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor, State of New York.

BLACK RIVER BASIN.

GENERAL FEATURES.

Black River rises in the western part of Hamilton County, N. Y., flows southwestward across Herkimer County into Oneida County, turns near Forestport and runs somewhat west of north through Lewis County to eastern Jefferson County, and then flows westward to Black River Bay, at the eastern extremity of Lake Ontario. Its total drainage area is 1,930 square miles. The upper part of the basin is very rugged and mountainous, contains a large number of lakes, and is in a part of the Adirondack forest.

The mean annual precipitation is about 40 inches, ranging from 55 inches in the extreme headwaters to perhaps 30 inches near Lake

Erie. The winters are generally quite severe, and the stream flow is affected by ice for periods of several months.

The regimen of the river is controlled by storage on its upper tributaries (including Beaver River at Beaver), a series of reservoirs at the headwaters of Moose River, and additional reservoirs at Forestport and on the headwaters of the main river.

Water is diverted from Black River through Forestport feeder to supply the Black River Canal at Boonville. A portion of this diverted water flows northward from Boonville and enters Black River again at Lyons Falls; the remainder flows southward through the Black River Canal and enters the Erie Canal at Rome.

BLACK RIVER NEAR FELTS MILLS, N. Y.

This station, which is located at the dam of the Harmon Paper Co., formerly owned by the Black River Traction Co., near the village of Felts Mills, 7 miles upstream from the old Huntingtonville gaging station on this stream, was established August 29, 1902. Since May 1, 1907, the station has been maintained by the State engineer and surveyor, by whom the 1910 data have been furnished for publication.

The dam is of sawed timber, rests on limestone foundation, and is very nearly water-tight. It has a slope on the upstream face of 2.88 horizontal to 1 vertical. The crest is protected by boiler plate, and the downstream face is vertical, giving a free overfall. The main crest is 380.6 feet long. There are two additional sections on the right-hand side, one 14.1 feet long and the other 17.9 feet. A similarly constructed dam, 117 feet long, at the left bank, serves as an auxiliary spillway and as a headrace wall.

During the summer of 1910 a new dam was constructed about 100 feet downstream from the paper mill. For description see Water-Supply Paper 304 (in preparation).

The gage, which is read twice daily, at 7 a. m. and 6 p. m., is attached vertically to a crib at the left-hand side of the stream above the mill. Correction is made to the gage readings for velocity of approach during high water. The discharge over the spillways has been calculated by means of the weir formula, using coefficients derived from experiments of the United States Geological Survey for a dam of similar cross section.

A wood-pulp mill has been constructed adjacent to this dam, and was put in operation during 1907. The mill contains four 72-inch and one 45-inch Smith-McCormick turbines. A record is kept of the hours run and gage opening of each wheel, as well as of the head under which the wheels operate.

Information in regard to this station is contained also in the reports of the New York State engineer and surveyor.

Daily discharge, in second-feet, of Black River near Felts Mills, N. Y., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,462	2,546	6,079	13,849	a 2,842	3,913	902	1,189	2,142	2,746	2,946	1,413
2	1,165	2,378	8,283	14,676	2,967	4,090	861	869	1,903	a2,562	2,558	1,413
3	2,123	2,420	10,472	a14,676	3,658	3,468	a 100	902	1,864	2,353	2,474	1,207
4	1,246	2,128	13,137	13,029	4,289	3,578	100	924	a1,784	2,311	2,474	a 1,207
5	1,370	2,036	14,161	11,211	6,024	a2,842	924	1,317	2,266	2,104	2,906	1,207
6	1,700	a 998	a13,849	9,823	6,495	3,205	896	3,263	2,266	2,144	a3,448	1,040
7	1,700	1,913	14,827	8,319	2,647	3,468	896	a3,406	1,945	2,661	3,237	1,040
8	1,320	1,341	14,553	8,086	a 4,747	4,371	868	3,143	1,905	2,784	2,964	873
9	a 1,040	1,597	13,481	7,319	4,128	5,045	832	2,620	1,786	a2,784	3,081	873
10	1,848	1,796	11,910	a 6,808	3,683	4,694	a 323	2,161	1,554	2,394	3,631	1,040
11	1,639	1,837	7,704	6,136	3,683	4,024	1,124	1,999	a1,372	2,025	5,158	a 1,207
12	1,389	1,718	8,231	5,183	3,534	a3,287	933	2,693	1,168	1,826	3,631	1,413
13	1,608	a 555	a 6,304	4,530	3,123	4,042	868	3,519	1,286	1,786	a4,312	1,597
14	2,169	2,018	6,291	3,933	2,699	3,500	896	a2,336	1,231	1,786	3,121	1,498
15	1,369	1,597	4,884	3,448	a 2,151	3,197	938	2,088	1,231	1,786	2,722	1,624
16	a 1,165	1,637	4,561	3,139	4,740	3,081	922	2,126	1,190	a1,594	2,516	1,564
17	1,805	1,716	3,496	a 2,545	4,233	2,662	a 754	1,786	1,190	1,268	2,349	1,442
18	1,303	2,005	3,365	2,545	4,816	2,607	1,365	1,865	a1,044	1,259	2,182	a 873
19	1,352	1,967	3,605	2,842	5,077	a1,888	901	1,983	1,190	1,259	2,019	1,442
20	1,608	a 1,249	a 4,094	4,560	5,699	3,159	911	2,023	1,231	1,308	a1,888	1,317
21	2,128	2,269	6,134	3,947	3,143	2,307	901	a2,023	1,190	1,317	1,655	1,067
22	2,800	1,921	7,255	3,469	a 2,842	2,142	902	1,983	1,190	1,217	1,352	1,067
23	a 4,530	1,963	7,731	2,842	3,500	1,903	863	1,877	1,190	(a)	1,475	1,067
24	6,715	2,046	8,498	a 3,029	3,465	1,594	a 515	1,435	1,190	1,268	1,655	1,067
25	6,183	2,130	8,753	3,635	4,062	1,511	1,183	1,090	a1,190	1,268	2,019	a 873
26	5,785	2,509	10,137	3,386	5,045	a 201	933	1,050	1,231	1,317	2,151	1,067
27	5,567	a 1,888	a11,978	3,980	4,062	1,231	942	1,035	1,236	1,826	a1,888	1,216
28	3,632	3,714	11,715	3,683	3,733	996	933	a1,035	1,231	2,946	1,655	1,337
29	2,823	.....	11,715	3,980	a 3,931	996	942	1,020	1,246	3,181	1,655	1,478
30	a 2,151	.....	11,211	2,829	3,941	996	881	1,040	2,746	a2,282	1,413	1,796
31	2,517	.....	10,708	.....	3,765	.....	a 674	1,058	.....	3,237	.....	2,242

a Sunday.

Monthly discharge, in second-feet, of Black River near Felts Mills, N. Y., for 1910.

[Drainage area, 1,851 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
January	6,715	1,040	2,426	1.311	1.508
February	3,714	555	1,925	1.040	1.082
March	14,827	3,365	9,004	4.864	5.594
April	14,676	2,545	6,048	3.267	3.659
May	6,495	2,151	3,959	2.139	2.460
June	5,045	201	2,800	1.513	1.695
July	1,365	100	838	.452	.520
August	3,519	869	1,834	.991	1.140
September	2,746	1,044	1,506	.814	.912
October (30 days)	3,237	1,217	2,020	1.091	a 1.255
November	5,158	1,352	2,551	1.378	1.543
December	2,242	873	1,276	.689	.792
The year	14,827	100	3,016	1.629	22.160

a Computed for 31 days.

MOOSE RIVER AT MOOSE RIVER, N. Y.

This station, which is located in the village of Moose River, about 3 miles downstream from the McKeever station on the Adirondack division of the New York Central & Hudson River Railroad, was established June 5, 1900.

At McKeever is a timber dam used for power and water regulation for log driving, so that during portions of the year two gage readings

a day may not give a good mean. From the dam to the station the velocity is relatively slow, but below the station it is very high. Just above the station is a small island, upon which ice and log jams occasionally form.

At the station the bed of the river is cobble with occasional large bowlders, the current is smooth, and the depth fairly uniform. The stream freezes over in winter with alternate layers of ice and snow.

Since July, 1903, discharge measurements have been made from a cable having a clear span of 269 feet. A staff gage divided into two parts is fastened to the left bank a short distance above the cable. The elevation of the gage zero was changed on February 28, 1903, from 15.36 to 15.53. A fairly accurate rating curve has been developed for the open-water channel.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Moose River at Moose River, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 12	W. G. Hoyt	218	768	2.51	862
July 11	J. J. Phelan	204	413	.88	260

Daily gage heights, in feet, of Moose River at Moose River, N. Y., for 1910.

[Chris. Hannon, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.1	.....	7.1	6.2	4.3	2.4	0.9	0.95	0.85	3.1	2.5	1.3
2	1.0	.....	6.95	6.1	4.2	2.9	.95	.95	.8	2.85	2.5	1.2
3	1.0	.....	6.5	5.95	4.2	3.25	.9	.95	.7	2.8	2.6	1.35
4	1.25	.....	5.65	5.8	4.1	2.9	1.0	2.4	.8	2.7	2.6	0.0
5	1.35	.....	5.1	5.2	4.2	2.9	1.1	4.1	.8	2.55	2.65	1.45
6	1.55	.....	4.8	5.05	4.35	3.2	1.2	3.2	.9	2.4	2.65	1.7
7	1.7	.....	4.8	5.35	4.05	3.55	1.1	2.95	1.05	2.25	2.6	1.6
8	1.7	.....	4.7	5.1	3.75	3.75	.95	2.65	1.4	2.2	2.45	1.35
9	.....	.....	4.8	4.35	3.4	3.7	1.0	2.3	1.35	2.05	2.35	.95
10	.....	.....	4.8	3.9	3.1	3.55	.9	2.45	1.3	2.0	2.3	.8
11	.....	.....	4.65	3.35	2.8	3.25	.9	3.0	1.3	1.9	2.2	.8
12	.....	.....	4.5	3.15	2.45	3.2	.8	3.35	1.4	1.8	2.1	.7
13	.....	.....	4.35	3.0	2.1	2.9	.8	3.1	1.35	1.65	2.1	.7
14	.....	.....	4.3	2.95	1.6	2.4	.8	2.7	1.45	1.6	2.0	.8
15	.....	.....	4.2	2.75	.3	2.2	.8	2.6	1.45	1.6	2.0	.8
16	.....	.....	4.0	2.7	1.2	2.05	.8	2.5	1.3	0.0	1.9	.9
17	.....	.....	3.55	2.7	1.4	2.0	.3	2.35	1.4	1.6	1.75	.8
18	.....	.....	3.3	2.6	1.65	1.9	.8	2.15	1.4	1.6	1.7	.7
19	.....	.....	3.1	2.6	2.0	1.8	.9	2.0	1.25	1.7	1.6	.7
20	.....	.....	2.85	2.5	2.3	1.7	.8	1.95	1.2	1.8	1.5	.8
21	.....	.....	2.6	2.5	2.45	1.6	.8	1.8	1.3	1.95	1.5	.8
22	.....	.....	2.85	2.4	2.7	1.5	.7	1.65	1.3	1.95	1.5	.7
23	.....	.....	3.3	2.4	3.0	1.3	.7	1.45	1.4	2.0	1.5	.8
24	.....	.....	4.05	2.4	3.25	.3	.8	1.2	1.4	2.15	1.6	.9
25	.....	.....	5.65	2.4	2.95	1.15	.9	.95	1.5	2.35	1.5	.95
26	.....	.....	6.35	3.1	2.9	1.15	.95	.75	1.5	2.55	1.5	.8
27	.....	.....	6.35	3.85	2.8	1.1	.9	.55	1.65	2.35	1.4	1.25
28	.....	.....	5.95	3.8	2.7	1.05	.8	0.0	1.95	2.3	1.4	1.7
29	.....	.....	6.3	3.95	2.55	1.0	.75	.6	2.4	2.2	1.4	1.75
30	.....	.....	6.15	4.25	2.35	.9	.9	.95	3.05	2.35	1.3	1.6
31	.....	.....	6.15	.....	2.2	.....	1.05	.9	.....	2.4	.....	1.45

NOTE.—Relation of gage height to discharge affected by the presence of ice during January and February, but probably not materially affected during December.

Daily discharge, in second-feet, of Moose River at Moose River, N. Y., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6,060	4,660	2,240	800	265	278	252	1,220	855	375
2	5,820	4,510	2,140	1,080	278	278	240	1,060	855	345
3	5,110	4,280	2,140	1,320	265	278	215	1,020	910	390
4	3,860	4,070	2,040	1,080	290	800	240	965	910	90
5	3,140	3,260	2,140	1,080	315	2,040	240	882	938	420
6	2,780	3,080	2,290	1,290	345	1,290	265	800	938	500
7	2,780	3,460	1,990	1,550	315	1,120	302	725	910	465
8	2,670	3,140	1,720	1,720	278	938	405	700	828	390
9	2,780	2,290	1,430	1,670	290	750	390	630	775	278
10	2,780	1,850	1,220	1,550	265	828	375	610	750	240
11	2,620	1,400	1,020	1,320	265	1,150	375	570	700	240
12	2,450	1,260	828	1,290	240	1,400	405	535	650	215
13	2,290	1,150	650	1,080	240	1,220	390	482	650	215
14	2,240	1,120	465	800	240	965	420	465	610	240
15	2,140	995	135	700	240	910	420	465	610	240
16	1,940	965	345	630	240	855	375	90	570	265
17	1,550	965	405	619	135	775	405	465	518	240
18	1,360	910	482	570	240	675	405	465	500	215
19	1,220	910	610	535	265	610	360	500	465	215
20	1,060	855	750	500	240	590	345	535	435	240
21	910	855	828	465	240	535	375	590	435	240
22	1,060	800	965	435	215	482	375	590	435	215
23	1,360	800	1,150	375	215	420	405	610	435	240
24	1,990	800	1,320	135	240	345	405	675	465	265
25	3,860	800	1,120	330	265	278	435	775	435	278
26	4,880	1,220	1,080	330	278	228	435	882	435	240
27	4,880	1,800	1,020	315	265	185	482	775	405	340
28	4,280	1,760	965	302	240	90	590	750	405	500
29	4,810	1,900	882	290	228	195	800	700	405	518
30	4,580	2,190	775	265	265	278	1,180	775	375	465
31	4,580	.....	700	.....	302	265	.....	800	.....	420

NOTE.—Daily discharge determined from a discharge rating curve well defined between 240 and 3,650 second-feet. The determination of daily discharge during December may be somewhat in error as a result of backwater from ice.

Monthly discharge of Moose River at Moose River, N. Y., for 1910.

[Drainage area, 346 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	600	1.73	1.99	D.
February	.....	.....	500	1.45	1.51	D.
March	6,060	910	3,030	8.76	10.10	C.
April	4,660	800	1,940	5.61	6.26	B.
May	2,290	135	1,160	3.35	3.86	B.
June	1,720	135	814	2.35	2.62	A.
July	345	135	258	.746	.86	A.
August	2,040	90	679	1.96	2.26	A.
September	1,180	215	410	1.18	1.32	A.
October	1,220	90	681	1.97	2.27	A.
November	938	375	620	1.79	2.00	B.
December	518	90	308	.890	1.03	C.
The year	6,060	90	917	2.65	36.08	

NOTE.—Monthly discharge for January and February estimated at approximately 25 per cent of the discharge of Black River at Felts Mills. This ratio holds quite consistently for these two stations during the open-water period.

The determination of mean discharge for November, as published in the Sixth Annual Report of the New York State Water Supply Commission and in the 1910 report of the State engineer and surveyor, was slightly in error and has been corrected in the above table.

STREAMS FLOWING DIRECTLY TO ST. LAWRENCE RIVER.

OSWEGATCHIE RIVER BASIN.

GENERAL FEATURES.

Oswegatchie River has its source in the region of lakes and timbered swamps in the southern part of St. Lawrence County, N. Y. The largest of the lakes is Cranberry Lake, which affords valuable storage to water-power users on its outlet, East Branch of Oswegatchie River. The East and West branches flow in a general northwesterly direction and unite near Talcville. From Gouverneur to Oxbow the river flows southwestward; it then turns sharply and flows northeastward to Rensselaer Falls, turns again to the northwest, receives the outlet of Black Lake at Galilee, and finally enters the St. Lawrence at Ogdensburg. Its total drainage area comprises about 1,600 square miles.

The mean annual precipitation is about 35 inches, and winter conditions are usually severe.

The basin affords many opportunities for water storage and the utilization of these sites is especially desirable on account of the quick-spilling character of this area and the tendency to floods. Considerable water power is developed, mostly in small units, and there is a large amount of undeveloped power.

OSWEGATCHIE RIVER NEAR OGDENSBURG, N. Y.

This station, which is located at what is known as the Eel Weir highway bridge, about 5½ miles upstream from Ogdensburg, N. Y., and about a mile below Black Lake outlet, was established April 22, 1903, and has been maintained continuously since that date.

There are three dams in the vicinity of the gaging station on Oswegatchie River—one at Heuvelton, about 5 miles above; one at Rensselaer Falls, 10 miles above; and one in the city of Ogdensburg, about half a mile above the outlet.

The channel is open at this station throughout the year. The stream bed is rocky and permanent, and the results are considered fairly good for all stages.

The datum of the chain gage attached to the bridge has remained the same since the beginning of the record.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission of New York and State engineer and surveyor, State of New York.

The following discharge measurement was made by W. G. Hoyt

August 24, 1910: Width, 150 feet; area of section, 297 square feet; gage height, 4.7[illegible] feet; discharge, 696 second-feet.

Daily gage height, in feet, of Oswegatchie River near Ogdensburg, N. Y., for 1910.

[Joseph La Rue, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.1	6.1	5.7	6.9	5.3	5.4	4.7	4.4	4.6	4.7	5.8	5.9
2	5.0	6.0	6.2	6.7	5.3	5.4	4.7	4.5	4.6	4.7	6.0	5.8
3	5.0	5.8	7.0	6.7	5.3	5.3	4.7	4.5	4.6	4.7	5.8	5.8
4	5.2	5.8	7.5	6.7	5.3	5.3	4.8	4.5	4.6	4.7	5.7	5.8
5	5.0	5.6	8.1	6.7	5.4	5.3	4.8	4.5	4.6	4.7	5.7	5.8
6	5.0	5.5	8.3	6.5	5.6	5.4	4.7	4.5	4.7	4.7	5.6	5.8
7	4.9	5.5	8.8	6.5	6.2	5.3	4.7	4.5	4.9	4.7	5.6	5.7
8	4.9	5.5	8.9	6.2	6.1	5.2	4.7	4.6	4.9	4.8	5.6	5.7
9	4.9	5.3	9.1	6.2	6.1	5.2	4.7	4.5	4.9	4.9	5.6	5.6
10	5.0	5.2	9.1	6.1	5.9	5.2	4.6	4.6	4.9	4.9	5.6	5.5
11	5.0	5.1	9.0	6.0	5.9	5.2	4.6	4.6	4.9	5.0	6.0	5.4
12	4.9	5.1	8.6	5.9	5.9	5.5	4.6	4.7	4.9	5.2	6.0	5.3
13	4.9	5.1	8.5	5.9	5.7	5.5	4.7	4.7	5.0	5.2	6.1	5.3
14	4.8	5.0	8.3	5.8	5.6	5.3	4.7	4.7	4.9	5.3	6.2	5.2
15	4.8	5.0	7.9	5.6	5.6	5.3	4.7	4.7	5.0	5.3	6.3	5.2
16	4.8	5.0	7.6	5.6	5.5	5.3	4.6	4.7	4.9	5.3	6.3	5.1
17	4.8	4.9	7.3	5.4	5.4	5.3	4.6	4.7	4.9	5.3	6.2	5.1
18	4.8	4.9	6.9	5.4	5.3	5.1	4.6	4.7	4.9	5.3	6.1	5.1
19	4.8	4.9	6.6	5.4	5.2	5.1	4.6	4.6	4.9	5.2	6.0	5.1
20	5.0	4.9	6.6	5.6	5.1	5.1	4.4	4.6	4.9	5.2	6.0	5.0
21	5.0	4.9	6.6	5.6	5.3	5.1	4.4	4.7	4.8	5.2	6.0	5.0
22	5.2	4.9	6.6	5.6	5.3	5.1	4.4	4.7	4.8	5.1	6.0	5.0
23	5.5	5.0	6.6	5.6	5.3	5.1	4.5	4.7	4.8	5.1	5.9	5.0
24	6.0	5.0	6.6	5.6	5.3	5.0	4.5	4.6	4.8	5.0	5.9	5.0
25	6.2	5.0	6.8	5.5	5.4	5.0	4.5	4.6	5.0	5.0	5.8	5.0
26	6.4	5.0	6.8	5.6	5.5	5.0	4.5	4.6	4.9	5.0	5.8	5.0
27	6.4	5.0	6.9	5.6	5.5	5.0	4.5	4.6	4.9	5.0	5.8	5.0
28	6.5	5.2	7.1	5.3	5.4	4.9	4.5	4.6	4.8	5.2	5.9	5.1
29	6.4	.....	7.1	5.3	5.5	4.8	4.5	4.6	4.8	5.3	6.0	5.1
30	6.3	.....	7.1	5.3	5.5	4.8	4.5	4.6	4.8	5.5	6.0	5.1
31	6.1	.....	7.2	.....	5.4	.....	4.4	4.6	.....	5.8	.....	5.2

NOTE.—Relation of gage height to discharge at this station not affected by ice.

Daily discharge, in second-feet, of Oswegatchie River near Ogdensburg, N. Y., for 1910.

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,380	3,730	2,640	6,070	1,770	1,970	720	330	580	720	2,890	3,160
2	1,200	3,440	4,020	5,480	1,770	1,970	720	450	580	720	3,440	2,890
3	1,200	2,890	6,360	5,480	1,770	1,770	720	450	580	720	2,890	2,890
4	1,570	2,890	7,850	5,480	1,770	1,770	870	450	580	720	2,640	2,890
5	1,200	2,400	9,660	5,480	1,970	1,770	870	450	580	720	2,640	2,890
6	1,200	2,180	10,300	4,890	2,400	1,970	720	450	720	720	2,400	2,890
7	1,030	2,180	11,800	4,890	4,020	1,770	720	450	1,030	720	2,400	2,640
8	1,030	2,180	12,100	4,020	3,730	1,570	720	580	1,030	870	2,400	2,640
9	1,030	1,770	12,700	4,020	3,730	1,570	720	450	1,030	1,030	2,400	2,400
10	1,200	1,570	12,700	3,730	3,160	1,570	580	580	1,030	1,030	2,400	2,180
11	1,200	1,380	12,400	3,440	3,160	1,570	580	580	1,030	1,200	3,440	1,970
12	1,030	1,380	11,200	3,160	3,160	2,180	580	720	1,030	1,570	3,440	1,770
13	1,030	1,380	10,900	3,160	2,640	2,180	720	720	1,200	1,570	3,730	1,770
14	870	1,200	10,300	2,890	2,400	1,770	720	720	1,030	1,770	4,020	1,570
15	870	1,200	9,050	2,400	2,400	1,770	720	720	1,200	1,770	4,310	1,570
16	870	1,200	8,150	2,400	2,180	1,770	580	720	1,030	1,770	4,310	1,380
17	870	1,030	7,250	1,970	1,970	1,770	580	720	1,030	1,770	4,020	1,380
18	870	1,030	6,070	1,970	1,770	1,380	580	720	1,030	1,770	3,730	1,380
19	870	1,030	5,180	1,970	1,570	1,380	580	580	1,030	1,570	3,440	1,380
20	1,200	1,030	5,180	2,400	1,380	1,380	330	580	1,030	1,570	3,440	1,200
21	1,200	1,030	5,180	2,400	1,770	1,380	330	720	870	1,570	3,440	1,200
22	1,570	1,030	5,180	2,400	1,770	1,380	330	720	870	1,380	3,440	1,200
23	2,180	1,200	5,180	2,400	1,770	1,380	450	720	870	1,380	3,160	1,200
24	3,440	1,200	5,180	2,400	1,770	1,200	450	580	870	1,200	3,160	1,200
25	4,020	1,200	5,780	2,180	1,970	1,200	450	580	1,200	1,200	2,890	1,200
26	4,600	1,200	5,780	2,400	2,180	1,200	450	580	1,030	1,200	2,890	1,200
27	4,600	1,200	6,070	2,400	2,180	1,200	450	580	1,030	1,200	2,890	1,200
28	4,890	1,570	6,660	1,770	1,970	1,030	450	580	870	1,570	3,160	1,380
29	4,600	.....	6,660	1,770	2,180	870	450	580	870	1,770	3,440	1,380
30	4,310	.....	6,660	1,770	2,180	870	450	580	870	2,180	3,440	1,380
31	3,730	.....	6,960	.....	1,970	.....	330	580	.....	2,890	.....	1,570

NOTE.—Daily discharge determined from a fairly well-defined discharge rating curve.

Monthly discharge of Oswegatchie River near Ogdensburg, N. Y., for 1910.

[Drainage area, 1,580 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	4,890	870	1,960	1.24	1.43	A.
February	3,730	1,030	1,670	1.06	1.10	A.
March	12,700	2,640	7,780	4.92	5.67	A.
April	6,070	1,770	3,240	2.05	2.29	A.
May	4,020	1,380	2,270	1.44	1.66	A.
June	2,180	870	1,550	.981	1.09	A.
July	870	330	578	.366	.42	B.
August	720	330	588	.372	.43	B.
September	1,200	580	924	.585	.65	B.
October	2,890	720	1,350	.854	.98	A.
November	4,310	2,400	3,210	2.03	2.26	A.
December	3,160	1,200	1,840	1.16	1.34	A.
The year	12,700	330	2,250	1.42	19.32	

RAQUETTE RIVER BASIN.

GENERAL FEATURES.

Raquette River drains a long, narrow basin extending from northern Hamilton County to St. Lawrence River. Its sources are on an elevated plateau, dotted with mountains, interspersed with lakes, in general timbered, and containing numerous marsh areas, many of which are on the divide and feed streams flowing into adjacent drainages.

The mean annual precipitation is about 38 inches, ranging from about 42 inches in the headwaters to 32 inches near the St. Lawrence. Winter conditions are the usual ones occurring in the Adirondack region, and snow and ice prevail for several months.

Raquette River possesses remarkable facilities for storage and has been very extensively studied by the State Water Supply Commission of New York. They propose a large reservoir at Tupper Lake to afford an effective storage of about 10,000,000,000 cubic feet. They further estimate that about double this amount will be required to adequately regulate the flow of the river. This additional storage it is planned to obtain by a system of smaller reservoirs, involving the following lakes and ponds: Little Tupper, Forked, Raquette, Blue Mountain, Utowana, Brandreth, Horseshoe, and Long lakes, South and Slim ponds, and Dead Creek.

The river also affords many opportunities for power development and, in the words of the State Water Supply Commission, "presents in many ways one of the most attractive fields for water-power and storage studies in the State."

RAQUETTE RIVER AT RAQUETTE FALLS, NEAR COREYS, N. Y.

This station, which is located near the center of Raquette Falls, about 6 miles by river upstream from the village of Axton, which is 12 miles by road from the village of Tupper Lake, was established August 27, 1908, in cooperation with the State Water Supply Commission of New York.

The river flows in one channel at all stages. The current is favorable for making discharge measurements. The bed is composed of large bowlders and is permanent. At low stage the current is sluggish; at high and medium stages the current is suitable for good discharge measurements.

The datum of the staff gage has remained the same during the maintenance of the station.

Measurements are made from a car hung from a cable which was erected during the summer of 1909. Previous to that time measurements were made by wading about 2,000 feet downstream.

The low-water portion of the curve is well defined. No measurements have as yet been made to determine the high-water discharge.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Raquette River at Raquette Falls, near Coreys, N. Y., for 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 1	C. C. Covert	106	623	5.8	3,730
May 26	W. G. Hoyt[1]	89	424	4.26	1,020
July 7	....do	88	252	2.00	294
July 23	C. C. Covert	67	184	1.40	141
Nov. 7	F. J. Shuttleworth	89	258	2.54	470

[1] Log jam below gage caused backwater.

Daily gage height, in feet, of Raquette River at Raquette Falls, near Coreys, N. Y., for 1910.

[C. A. De Lancett, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.75	4.2	4.3	2.4	1.5	1.6	1.9	2.4	2.1
2	.....	5.8	4.4	4.5	2.2	1.5	1.7	2.0	2.4	2.1
3	.....	5.6	4.5	4.5	2.1	1.4	1.7	2.0	2.4	2.1
4	.....	5.4	5.1	4.0	2.1	1.7	1.8	2.0	2.4	2.1
5	.....	5.4	5.6	3.8	2.1	1.9	1.9	2.0	2.4	2.1
6	.....	5.3	5.4	3.9	2.1	1.9	2.5	2.0	2.4	2.1
7	.....	5.4	5.2	4.0	2.0	1.8	2.5	2.0	2.5	2.2
8	.....	5.5	5.2	4.2	1.9	1.7	2.5	2.0	2.5	2.4
9	.....	5.4	5.1	4.1	1.9	1.7	2.4	2.0	2.5	2.7
10	.....	5.4	5.1	4.1	1.8	1.7	2.3	2.0	2.5	2.8
11	.....	5.4	5.0	4.1	1.8	1.6	2.2	2.0	2.4	3.0
12	.....	5.1	4.8	4.1	1.8	1.6	2.2	2.0	2.4	3.0
13	.....	4.9	4.6	3.9	1.8	1.6	2.2	2.0	2.4	2.9
14	.....	4.7	4.4	3.8	1.7	1.6	2.1	2.0	2.4	2.7
15	.....	4.7	4.3	3.6	1.6	1.8	2.1	2.0	2.4	2.7
16	.....	4.5	4.3	3.6	1.6	1.8	2.0	2.0	2.3	2.5
17	.....	4.5	4.3	3.6	1.6	1.9	2.0	2.0	2.3	2.3
18	.....	4.5	4.4	3.6	1.6	2.0	2.0	1.9	2.3	2.1
19	.....	4.7	4.4	3.5	1.5	1.9	2.0	1.9	2.2	2.1
20	.....	5.1	4.0	3.4	1.5	1.8	2.0	1.9	2.2	2.0
21	.....	4.9	4.1	3.3	1.5	1.8	1.9	1.8	2.2	1.9
22	.....	5.1	3.9	3.2	1.5	1.7	1.9	1.8	2.2	1.9
23	.....	4.9	3.5	3.0	1.4	1.6	1.9	1.9	2.2	1.9
24	.....	4.7	3.7	2.9	1.4	1.6	1.9	1.9	2.1	1.9
25	.....	4.5	3.9	2.8	1.4	1.7	1.9	2.1	2.1	1.9
26	.....	4.4	4.1	2.8	1.5	1.8	1.8	2.3	2.1	1.9
27	.....	4.3	4.3	2.7	1.6	1.8	1.8	2.3	2.1	1.8
28	.....	4.3	4.8	2.6	1.6	1.7	1.8	2.3	2.1	1.8
29	.....	4.2	3.7	2.5	1.5	1.7	1.8	2.3	2.1	1.9
30	5.15	4.2	3.8	2.4	1.5	1.6	1.8	2.4	2.2	2.1
31	5.65	.....	4.3	.....	1.5	1.6	.....	2.4	.....	2.3

NOTE.—Ice present at this station from Jan. 1 to about Mar. 29, and from about Dec. 7 to 31. The gage readings during December were probably to water surface.

For a few days in the latter part of May the gage heights were affected by backwater from a log jam, which was probably carried out May 28 by flood from Cold River.

Daily discharge, in second-feet, of Raquette River at Raquette Falls, near Coreys, N. Y., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3,660	1,640	1,750	420	170	190	265	420	320
2	.....	3,740	1,860	1,970	350	170	215	290	420	320
3	.....	3,430	1,970	1,970	320	150	215	290	420	320
4	.....	3,130	2,700	1,450	320	215	240	290	420	320
5	.....	3,130	3,430	1,280	320	265	265	290	420	320
6	.....	2,980	3,130	1,360	320	265	460	290	420	320
7	.....	3,130	2,840	1,450	290	240	460	290	460	.....
8	.....	3,280	2,840	1,640	265	215	460	290	460	.....
9	.....	3,130	2,700	1,540	265	215	420	290	460	.....
10	.....	3,130	2,700	1,540	240	215	385	290	460	.....
11	.....	3,130	2,570	1,540	240	190	350	290	420	.....
12	.....	2,700	2,320	1,540	240	190	350	290	420	.....
13	.....	2,440	2,080	1,360	240	190	350	290	420	.....
14	.....	2,200	1,860	1,280	215	190	320	290	420	.....
15	.....	2,200	1,750	1,120	190	240	320	290	420	.....
16	.....	1,970	1,750	1,120	190	240	290	290	385	.....
17	.....	1,970	1,750	1,120	190	265	290	290	385	.....
18	.....	1,970	1,860	1,120	190	290	290	265	385	.....
19	.....	2,200	1,860	1,040	170	265	290	265	350	.....
20	.....	2,700	1,450	970	170	240	290	265	350	.....
21	.....	2,440	1,540	900	170	240	265	240	350	.....
22	.....	2,700	1,360	830	170	215	265	240	350	.....
23	.....	2,440	1,040	710	150	190	265	265	350	.....
24	.....	2,200	1,200	655	150	190	265	265	320	.....
25	.....	1,970	1,360	600	150	215	265	320	320	.....
26	.....	1,860	1,540	600	170	240	240	385	320	.....
27	.....	1,750	1,750	550	190	240	240	385	320	.....
28	.....	1,750	2,320	505	190	215	240	385	320	.....
29	.....	1,640	1,200	460	170	215	240	385	320	.....
30	2,770	1,640	1,280	420	170	190	240	420	350	.....
31	3,430	.....	1,750	.....	170	190	.....	420	.....	.....

NOTE.—Daily discharges determined from a fairly well defined discharge rating curve. No correction made for effect of log jam the latter part of May.

Monthly discharge of Raquette River at Raquette Falls, near Coreys, N. Y., for 1910.

[Drainage area, 418 square miles.]

Month.	Discharge in second-feet.			Second-feet per square mile.	Run-off (inches on drainage area).	Run-off (per cent of precipitation).
	Maximum.	Minimum.	Mean.			
January			250	0.598	0.69	D.
February			300	.718	.75	D.
March			1,500	3.59	4.14	D.
April	3,740	1,640	2,550	6.10	6.81	B.
May	3,430	1,040	1,980	4.74	5.46	B.
June	1,970	420	1,150	2.75	3.07	B.
July	420	150	226	.541	.62	B.
August	290	150	218	.522	.60	B.
September	460	190	299	.715	.80	B.
October	420	240	304	.727	.84	B.
November	460	320	388	.928	1.04	B.
December			200	.478	.55	D.
The year	3,740		780	1.87	25.37	

NOTE.—Mean discharge for January, February, March, and December has been estimated from the discharge at Piercefield and at other stations in northern New York. The determinations are only approximate.

No revision has been made in the discharge published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor.

RAQUETTE RIVER AT PIERCEFIELD, N. Y.

This station, which is located about three-fourths of a mile above the head of Black Rapids, one-half mile downstream from the dam of the International Paper Co. at Piercefield, and about 12½ miles below the mouth of Bog River, where it enters Tupper Lake, was established August 20, 1908, in cooperation with the New York State Water Supply Commission.

A vertical-staff gage was used from the date of establishment to September 3, 1910. After September 3, 1910, a chain gage, located at the same point as the staff gage, has been used. The gage datum has remained constant since the establishment of the station.

The bed of the stream is rocky, rough, and permanent, and a good discharge rating curve has been developed. The head of Black Rapids forms a pool extending back as far as the tailrace of the power plant of the International Paper Co.

During the low-water period the dam of the International Paper Co. controls the flow of the stream at the gaging station, but the mill usually runs for 24 hours each day except Sunday, on which day there is considerable decrease in stage.

Discharge measurements at low and medium stages are made from a boat just above Black Rapids. High-water measurements are made from the highway bridge about three-fourths of a mile above the station and one-fourth mile above the dam of the International Paper Co.

The relation of gage height to discharge is seldom affected by ice when the gage observations are made to water surface, as the swift

water in Black Rapids and at the control point at the head of the rapids rarely freezes. Several measurements made during the winter indicate that the open-water discharge rating curve is applicable during the winter.

Although the discharge at this station is somewhat affected by artificial control, the records are believed to be fairly good.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Raquette River at Piercefield, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 28[a]	C. C. Covert	124	2,020	5.7	2,920
31[a]	do	124	2,020	6.6	3,670
May 27[a]	W. G. Hoyt	124	1,920	5.25	2,430
July 8[b]	do	97	548	2.22	586
Aug. 19[b]	do	98	499	2.12	566

[a] Measurement made at highway bridge above dam. Pond above and underneath bridge full of pulp wood, which affected the surface velocities.
[b] Measurement made from boat at cable.

Daily gage height, in feet, of Raquette River at Piercefield, N. Y., for 1910.

[W. B. Graves, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	2.65	2.4	.....	6.8	.....	4.8	1.6	1.9	2.1	2.4	2.5
2	1.0	2.6	2.7	.....	6.8	.....	4.35	1.4	1.8	1.0	2.48	2.3
3	2.0	2.6	2.7	7.45	6.8	.....	1.0	1.4	1.7	1.35	2.50	2.3
4	1.95	.....	2.7	7.5	6.85	.....	1.0	1.3	.0	2.1	2.58	.0
5	.....	2.6	2.7	7.5	6.85	.....	3.5	1.4	.0	2.15	2.5	2.12
6	2.0	1.5	1.85	7.55	6.7	.....	3.4	1.4	1.85	2.1	.15	2.25
7	.....	2.5	3.35	7.5	6.6	.....	2.9	.0	2.12	2.15	1.55	2.2
8	1.9	2.7	4.25	7.5	6.4	.....	2.25	.0	2.1	2.2	2.25	2.0
9	1.1	2.6	4.25	7.5	6.4	.....	2.3	1.65	2.15	.15	2.40	1.9
10	2.0	.....	4.25	7.3	6.4	.....	1.0	2.0	2.2	.85	3.05	1.9
11	.....	.....	4.25	7.5	6.4	.....	2.1	.0	.0	1.75	2.65	.0
12	2.0	2.5	4.25	7.5	6.35	.....	2.2	.0	3.25	2.10	2.75	.0
13	2.6	2.4	3.6	7.5	6.3	.....	1.95	.0	2.3	2.05	.0	2.1
14	2.6	2.7	4.8	7.4	5.9	.....	2.2	.0	1.95	2.10	1.7	2.05
15	2.0	.....	4.8	7.3	5.45	.....	2.0	.0	1.75	2.00	3.05	2.0
16	1.1	2.7	4.85	7.1	5.6	.....	1.9	.0	1.9	.15	3.2	2.0
17	.....	.....	4.85	6.8	5.55	.....	1.0	.0	1.6	2.05	3.15	1.55
18	1.95	2.7	4.85	6.75	5.5	.....	2.0	1.0	.2	2.20	3.05	.0
19	1.8	2.7	4.8	6.9	5.4	.....	2.0	2.15	2.2	2.35	3.10	1.5
20	2.0	2.7	4.65	6.4	5.1	.....	2.05	1.65	2.2	2.40	.0	2.0
21	.....	2.7	4.65	6.5	5.4	.....	2.1	.3	2.2	2.40	1.6	1.9
22	2.0	2.7	4.6	6.4	5.6	.....	2.15	.0	2.2	2.40	2.4	1.9
23	1.0	2.7	4.5	6.4	5.6	.....	2.2	1.32	2.2	.15	2.8	1.9
24	2.45	2.7	4.5	5.9	5.6	.....	1.0	1.9	2.2	1.3	3.0	1.9
25	2.5	2.7	4.5	7.0	5.6	4.8	1.75	2.15	.2	2.05	3.0	.0
26	2.5	2.9	4.8	6.8	5.4	4.6	2.15	2.05	1.0	2.15	3.1	.0
27	2.5	1.9	5.1	6.8	5.4	4.8	2.2	2.0	1.35	2.20	.0	.0
28	2.5	.....	6.1	6.9	5.4	5.4	2.2	.2	2.15	2.32	1.65	.0
29	2.5	.....	6.4	6.9	5.4	5.4	1.95	.0	2.2	2.4	2.4	.0
30	2.1	.....	6.9	6.8	5.4	4.8	1.9	1.75	2.1	.2	2.5	.0
31	2.55	.....	6.65	.....	5.4	.....	.0	2.05	.....	1.55	.....	.0

NOTE.—Some of the gage readings for this station are erroneous, and for this cause gage readings as recorded by the observer from June 1 to 24 are omitted altogether. The readings recorded as 0 in the above table are especially incorrect, the gage height probably being considerably higher on those days. In the period Dec. 27 to 31 the plant of the International Paper Co. is known to have been in operation; on other days for which the gage height is recorded as 0 or other abnormally low value, the plant is assumed to have been closed and the discharge stored above the dam.

Gage heights Jan. 1 to Mar. 12 are to the top of ice. December gage heights are probably to water surface.

Daily discharge, in second-feet, of Raquette River at Piercefield, N. Y., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	487	735	635	3,820	3,980	.....	2,020	369	456	521	635	675
2	218	715	755	4,720	3,980	.....	1,680	316	426	218	667	595
3	487	715	755	4,720	3,980	.....	218	316	397	303	675	595
4	472	715	755	4,780	4,040	.....	218	290	90	521	707	90
5	480	715	755	4,780	4,040	.....	1,160	316	90	539	675	528
6	487	342	441	4,840	3,870	.....	1,000	316	441	521	101	576
7	472	675	1,080	4,780	3,760	.....	845	90	528	539	356	557
8	456	755	1,600	4,780	3,560	.....	576	90	521	557	576	487
9	241	715	1,600	4,780	3,560	.....	595	383	539	101	635	456
10	487	715	1,600	4,540	3,560	.....	218	487	557	186	920	456
11	487	675	1,600	4,780	3,560	.....	521	90	90	412	735	90
12	487	675	1,600	4,780	3,500	.....	557	90	1,020	521	778	90
13	715	635	1,220	4,780	3,450	.....	472	90	595	504	90	521
14	715	755	2,020	4,660	3,050	.....	557	90	472	521	397	504
15	487	755	2,020	4,540	2,600	.....	487	90	412	487	920	487
16	241	755	2,060	4,320	2,750	.....	456	90	456	101	995	487
17	356	755	2,060	3,980	2,700	.....	218	90	369	504	970	356
18	472	755	2,060	3,920	2,650	.....	487	218	105	557	920	90
19	426	755	2,020	4,090	2,560	.....	487	539	557	615	945	342
20	487	755	1,900	3,560	2,290	.....	504	383	557	635	90	487
21	487	755	1,900	3,660	2,560	.....	521	114	557	635	369	456
22	487	755	1,860	3,560	2,750	.....	539	90	557	635	635	456
23	218	755	1,780	3,560	2,750	.....	557	295	557	101	800	456
24	655	755	1,780	3,050	2,750	.....	218	456	557	290	895	456
25	675	755	1,780	4,200	2,750	2,020	412	539	105	504	895	90
26	675	845	2,020	3,980	2,560	1,860	539	504	218	539	945	90
27	675	456	2,290	3,980	2,560	2,020	557	487	303	557	90	450
28	675	456	3,250	4,090	2,560	2,560	557	105	539	603	383	450
29	675	.....	3,560	4,090	2,560	2,560	472	90	557	635	635	450
30	521	.....	4,090	3,980	2,560	2,020	456	412	521	105	675	450
31	695	.....	3,820	.....	2,560	.....	90	504	.....	356	.....	450

NOTE.—Daily discharge determined from a well-defined discharge rating curve. During the period Jan. 1 to Mar. 12, when the gage heights were taken to the top of the ice, the discharge rating curve was applied directly, as the ice was less than one-half foot thick and was probably constantly in a state of flotation. Discharge interpolated for days on which gage heights are missing, except on Feb. 28 and April 1 and 2 when it was estimated. Discharge for days on which gage height was recorded as 0 estimated at 90 second-feet, except Dec. 27 to 31, when the plant of the International Paper Co. is known to have been running. For these days the discharge is estimated at 450 second-feet. The discharge for the period Aug. 11 to 17 is subject to considerable doubt.

Monthly discharge of Raquette River at Piercefield, N. Y., for 1910.

[Drainage area, 723 square miles.]

Month.	Discharge in second-feet.				Run-off (inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.		
January	695	218	503	0.696	0.80	C.
February	845	342	700	.968	1.01	C.
March	4,090	635	1,830	2.53	2.92	C.
April	4,840	3,050	4,270	5.91	6.59	C.
May	4,040	2,290	3,110	4.30	4.96	C.
June	.....	.....	2,040	2.82	3.15	C.
July	2,020	90	587	.812	.94	C.
August	539	90	269	.372	.43	C.
September	1,020	90	438	.606	.68	C.
October	635	101	446	.617	.71	C.
November	995	90	637	.881	.98	C.
December	675	90	410	.567	.65	C.
The year	4,840	90	1,270	1.757	23.82	

NOTE.—Discharge for June estimated from the discharge at Massena Springs. Monthly discharge for this station, as published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the New York State engineer and surveyor, has been corrected.

RAQUETTE RIVER AT MASSENA SPRINGS, N. Y.

This station, which is located at the highway bridge at Massena Springs, 1,000 feet above the New York Central & Hudson River Railroad bridge, used for freight transfer from the railroad station to Massena power plant, 8 miles below Raymondville, and about 10 miles above the mouth of the river, was established September 21, 1903, temporarily discontinued October 17, 1903, and reestablished April 9, 1904.

The nearest power plant is at Raymondville, about 8 miles above the station. The Sunday flow of the stream is often held back during the low-water season while ponds at mills above are being refilled, and under these conditions the effect of the storage may be shown in the stream for several days.

The original gage was a vertical staff fastened to a stone masonry wall on the left bank, 25 feet upstream from the bridge. This gage was replaced August 16, 1906, by a standard chain gage fastened to the upstream side of the highway bridge. The datum of the chain gage was made 1 foot lower than that of the staff gage in order to avoid negative readings.

Ice forms at this station to a thickness of 3 feet, and the gage records for December, January, February, and March are usually much affected.

Determinations of monthly discharge are considered good, but during the low-water period daily discharges may be considerably in error as a result of artificial control.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Raquette River at Massena Springs, N. Y., for 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 30	C. C. Covert	173	1,110	6.38	4,680
Aug. 23	W. G. Hoyt	166	341	1.90	597

Daily gage height, in feet, of Raquette River at Massena Springs, N. Y., for 1910.

[F. L. Babcock, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.95	4.7	4.65	3.35	2.05	1.65	1.85	2.5	2.1
2	.....	7.1	4.7	4.65	3.2	2.0	1.62	2.15	2.15	2.3
3	.....	7.2	4.75	4.5	3.1	2.1	1.75	1.5	2.75	2.65
4	.....	7.15	5.05	4.35	2.3	1.9	1.25	2.15	2.85	2.4
5	.....	7.05	5.95	4.1	3.35	1.75	1.7	1.95	2.95	2.85
6	.....	7.15	6.0	4.4	2.85	1.65	2.2	2.1	2.85	3.05
7	.....	7.05	5.65	4.25	2.2	1.85	2.15	1.9	3.05	3.45
8	.....	6.95	5.5	4.8	1.85	2.0	2.3	2.7	2.95	3.55
9	.....	7.0	5.65	5.0	1.75	2.8	2.45	3.35	2.4	3.6
10	.....	6.85	5.65	4.85	2.35	2.45	2.65	3.0	2.65	4.1
11	.....	6.95	5.55	4.75	2.05	1.7	2.5	2.8	3.2	4.25
12	7.6	6.95	5.65	4.75	2.25	1.6	2.2	2.35	3.05	4.15
13	7.7	7.05	5.65	4.9	2.2	1.65	2.35	2.2	3.1	3.7
14	7.8	6.95	5.7	4.5	1.7	1.55	2.35	3.15	3.35	3.85
15	7.5	6.95	5.25	4.45	1.88	1.75	2.15	2.55	3.4	3.75
16	7.45	6.55	5.25	4.6	2.15	1.75	2.35	2.3	2.95	3.6
17	7.25	6.2	5.35	4.35	2.05	1.8	2.55	2.0	3.15	3.85
18	6.9	6.3	5.25	4.35	1.75	1.65	2.1	2.5	3.25	3.95
19	6.65	6.25	5.1	4.45	2.12	1.65	2.15	2.4	3.05	4.05
20	7.15	6.35	4.85	4.7	2.15	1.4	2.25	1.95	2.85	3.0
21	6.95	6.25	4.7	4.15	2.15	1.25	2.05	1.8	2.8	.....
22	6.9	5.8	4.9	4.15	1.65	1.45	1.6	2.0	3.25	.....
23	6.6	5.6	4.95	4.05	1.9	1.85	1.4	2.25	2.55	.....
24	6.1	5.25	4.65	3.9	1.8	2.05	1.6	2.15	2.35	.....
25	6.3	5.5	4.65	3.72	1.6	1.9	1.65	2.4	2.85	.....
26	6.55	5.4	4.75	3.6	2.2	1.7	1.65	2.45	3.05	.....
27	6.75	5.25	4.75	3.3	2.25	1.7	2.05	2.75	2.8	3.4
28	6.8	5.15	4.75	3.3	1.7	1.55	2.3	3.05	2.75	.....
29	6.4	5.05	4.65	3.05	1.6	1.55	1.6	3.3	2.95	.....
30	6.45	4.9	4.5	3.08	1.75	2.0	1.75	3.1	1.65	.....
31	6.6	.....	4.35	.....	2.15	1.4	.....	3.0	.....	.....

NOTE.—Ice present at this station from Jan. 1 to Mar. 11 and from Dec. 1 to 31. Gage heights during December to water surface.

Daily discharge, in second-feet, of Raquette River at Massena Springs, N. Y., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,050	5,210	2,790	2,740	1,590	675	457	559	955	.....
2	1,050	5,400	2,790	2,740	1,470	645	443	735	735	.....
3	1,050	5,520	2,840	2,600	1,390	705	506	388	1,120	.....
4	1,050	5,460	3,120	2,460	825	586	284	735	1,200	.....
5	1,050	5,330	4,060	2,240	1,590	506	481	616	1,270	.....
6	1,050	5,460	4,110	2,500	1,200	457	765	705	1,200	.....
7	1,480	5,330	3,730	2,370	765	559	735	586	1,350	.....
8	2,200	5,210	3,580	2,880	559	645	825	1,090	1,270	.....
9	3,000	5,270	3,730	3,080	506	1,160	922	1,590	890	.....
10	3,500	5,090	3,730	2,930	858	922	1,060	1,310	1,060	.....
11	5,000	5,210	3,630	2,840	675	481	955	1,160	1,470	.....
12	6,040	5,210	3,730	2,840	795	433	765	858	1,350	.....
13	6,180	5,330	3,730	2,980	765	457	858	765	1,390	.....
14	6,310	5,210	3,780	2,600	481	410	858	1,440	1,590	.....
15	5,900	5,210	3,320	2,550	575	506	735	988	1,630	.....
16	5,840	4,730	3,320	2,700	735	506	858	825	1,270	.....
17	5,580	4,330	3,420	2,460	675	532	988	645	1,430	.....
18	5,150	4,440	3,320	2,460	506	457	705	955	1,510	.....
19	4,850	4,390	3,180	2,550	717	457	735	890	1,350	.....
20	5,460	4,500	2,930	2,790	735	345	795	616	1,200	.....
21	5,210	4,390	2,790	2,280	735	284	675	532	1,160	.....
22	5,150	3,890	2,980	2,280	457	366	433	645	1,510	.....
23	4,790	3,680	3,030	2,190	586	559	345	795	988	.....
24	4,220	3,320	2,740	2,060	532	675	433	735	858	.....
25	4,440	3,580	2,740	1,900	433	586	457	890	1,200	.....
26	4,730	3,480	2,840	1,800	765	481	457	922	1,350	.....
27	4,970	3,320	2,840	1,550	795	481	675	1,120	1,160	.....
28	5,030	3,220	2,840	1,550	481	410	825	1,350	1,120	.....
29	4,560	3,120	2,740	1,350	433	410	433	1,550	1,270	.....
30	4,620	2,980	2,600	1,370	506	645	506	1,390	457	.....
31	4,790	.....	2,460	.....	735	345	.....	1,310	.....	.....

NOTE.—Daily discharges determined from a well-defined discharge rating curve. Discharge Mar. 1 to 11 estimated from the discharge at Piercefield.

Monthly discharge of Raquette River at Massena Springs, N. Y., for 1910.

[Discharge area, 1,170 square miles.]

Month.	Discharge in second-feet.				Run-off (inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.		
January	.....	.....	690	0.590	0.68	D.
February	.....	.....	960	.820	.85	D.
March	6,310	.....	4,040	3.45	3.98	B.
April	5,520	2,980	4,560	3.90	4.35	A.
May	4,110	2,460	3,210	2.74	3.16	A.
June	3,080	1,350	2,390	2.04	2.28	A.
July	1,590	433	770	.658	.76	A.
August	1,160	284	538	.460	.53	A.
September	1,060	284	666	.569	.63	A.
October	1,590	388	926	.791	.91	A.
November	1,630	457	1,210	1.03	1.15	A.
December	.....	.....	660	.564	.65	D.
The year	6,310	284	1,720	1.47	19.93	

NOTE.—Discharge for January, February, and December estimated from the discharge at Piercefield. No revision has been made in the determinations of discharge published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor.

BOG RIVER NEAR TUPPER LAKE, N. Y.

This station, which is located above Bog River Falls, about 300 feet below the forks of Tupper Lake stream and Bog River, about 2½ miles above Big Tupper Lake in the town of Piercefield, and about 11 miles southwest of the town of Tupper Lake, was established August 24, 1908.

The staff gage is located about 2½ miles downstream at the head of Bog River Falls and is within a few rods of Big Tupper Lake. The elevation of the zero of the gage determined by the United States Geological Survey bench mark at Tupper Lake Junction, according to the levels of the State Water Supply Commission of New York, is 1,563.76 feet above mean tide.

The bed of the stream is sandy and contains scattered bowlders, but it is probably permanent and a good low-water rating curve has been developed.

Since the summer of 1909 discharge measurements are made from a car hung on a cable. Before that time the measurements were made by wading or from a boat.

Gage readings previous to 1910 were obtained either by a recording gage or by hydrographers and other engineers, who periodically visit the station.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Bog River near Tupper Lake, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 2	C. C. Covert	72	220	2.82	368
May 20	W. G. Hoyt	65	245	3.06	494
25	....do	75	289	3.38	664
July 6	....do	51	108	1.53	101

Daily gage height, in feet, of Bog River near Tupper Lake, N. Y., for 1910.

[B. O. Lott, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.1	3.4	1.3	1.0	1.0	1.4	1.6
2	.....	5.05	3.3	1.3	1.0	1.1	1.5	1.6
3	3.1	4.95	3.2	1.3	1.0	1.2	1.5	1.6
4	2.7	2.65	3.2	1.2	1.0	1.3	1.4	1.6
5	3.1	3.8	3.0	1.2	1.0	1.3	1.5	1.7
6	2.9	3.6	2.8	1.4	1.0	1.2	1.5	1.8
7	2.2	4.45	2.6	1.5	1.0	1.2	1.5	1.8
8	3.7	2.4	2.5	1.5	1.0	1.3	1.4	1.7
9	3.8	5.0	2.5	1.4	1.1	1.4	1.3	1.7
10	3.5	4.95	2.7	1.2	1.2	1.5	1.3	1.7
11	3.8	4.8	2.8	1.3	1.2	1.55	1.3	1.8
12	4.2	4.3	2.7	1.3	1.2	1.5	1.4	1.9
13	3.7	2.7	2.6	1.2	1.1	1.5	1.5	1.9
14	3.6	2.3	2.5	1.1	1.0	1.4	1.5	2.0
15	3.4	2.1	2.5	1.1	1.0	1.4	1.6	2.3
16	5.1	2.1	2.5	1.1	1.0	1.3	1.5	2.4
17	4.8	2.1	2.6	1.1	1.1	1.2	1.4	2.3
18	4.6	2.3	2.8	1.1	1.1	1.3	1.4	2.3
19	2.7	2.2	3.0	1.1	1.0	1.3	1.3	2.3
20	4.1	4.6	2.8	1.1	1.0	1.3	1.3	2.3
21	4.55	4.5	2.6	1.1	1.0	1.4	1.5	2.3
22	1.9	3.1	2.6	1.1	1.0	1.3	1.6	2.3
23	3.1	3.0	2.4	1.1	1.0	1.3	1.5	2.3
24	2.1	3.2	2.1	1.1	1.0	1.3	1.5	2.3
25	1.2	3.45	2.0	1.0	1.0	1.3	1.5	2.4
26	1.6	3.4	1.8	1.0	.9	1.3	1.6	2.4
27	1.9	3.4	1.5	1.0	.8	1.3	1.6	2.1
28	1.9	3.4	1.4	1.1	.8	1.3	1.7	2.0
29	2.0	3.4	1.4	1.1	.8	1.3	1.7	2.0
30	5.05	3.5	1.4	1.2	.8	1.3	1.6	1.9
31	.....	3.4	.....	1.1	.9	.....	1.6	.....

NOTE.—No observations of gage heights for periods during which ice was present.

Daily discharge, in second-feet, of Bog River near Tupper Lake, N. Y., for 1910.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	500	186	625	60	28	28	72	100
2	500	1,650	580	60	28	37	85	100
3	495	1,580	535	60	28	48	85	100
4	340	325	535	48	28	60	72	100
5	495	825	455	48	28	60	85	115
6	415	720	375	72	28	48	85	131
7	208	1,230	310	85	28	48	85	131
8	770	254	280	85	28	60	72	115
9	825	1,610	280	72	37	72	60	115
10	670	1,580	340	48	48	85	60	115
11	825	1,470	375	60	48	92	60	131
12	1,060	1,130	340	60	48	85	72	148
13	770	340	310	48	37	85	85	148
14	720	230	280	37	28	72	85	166
15	625	186	280	37	28	72	100	230
16	1,690	186	280	37	28	60	85	254
17	1,470	186	310	37	37	48	72	230
18	1,330	230	375	37	37	60	72	230
19	340	208	455	37	28	60	60	230
20	1,000	1,330	375	37	28	60	60	230
21	1,300	1,260	310	37	28	72	85	230
22	148	495	310	37	28	60	100	230
23	495	455	254	37	28	60	85	230
24	186	535	186	37	28	60	85	230
25	48	648	166	28	28	60	85	254
26	100	625	131	28	20	60	100	254
27	148	625	85	28	14	60	100	186
28	148	625	72	37	14	60	115	166
29	166	625	72	37	14	60	115	166
30	1,650	670	72	48	14	60	100	148
31	.....	625	.....	37	20	.....	100	.....

NOTE.—Daily discharge determined from a discharge rating curve fairly well defined below about 800 second-feet. Discharge Apr. 1 and 2 estimated.

Monthly discharge of Bog River near Tupper Lake, N. Y., for 1910.

[Drainage area, 132 square miles.]

Month.	Discharge in second-feet.				Run-off (inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.		
January	.....	.....	100	0.758	0.87	D
February	.....	.....	100	.758	.79	D.
March	.....	.....	500	3.79	4.37	D.
April	1,690	48	648	4.91	5.48	B.
May	1,650	186	730	5.53	6.38	B.
June	625	72	312	2.36	2.63	B.
July	85	28	47.0	.356	.41	B.
August	48	14	28.8	.218	.25	B.
September	92	28	61.7	.467	.52	B.
October	115	60	83.3	.631	.73	B.
November	254	100	140	1.06	1.18	B.
December	.....	.....	80	.606	.70	D.
The year	1,690	14	236	1.79	24.31	

NOTE.—Monthly discharge for January, February, March, and December estimated from a consideration of general conditions of run-off in northern New York. Values approximate.

No revision has been made of discharge data published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the New York State engineer and surveyor, although values for April published in those reports were changed by the addition of the estimated discharge on Apr. 1 and 2.

ST. REGIS RIVER BASIN.

GENERAL FEATURES.

St. Regis River rises in several small streams and lakes in the western part of Franklin County, at an elevation of about 1,500 feet above sea level, flows northwestward about 40 miles and then somewhat east of north for about 28 miles to its junction with St. Lawrence River near the State line. Its drainage area comprises 664 square miles.[1] The upper part of the basin consists of swamps and mountains from which most of the forest has been largely cut. On leaving the plateau the stream descends for 10 or 15 miles, in a succession of steep rapids and precipitous falls, through a rugged country to the lowlands bordering the St. Lawrence. In this stretch are excellent power sites, only a few of which have as yet been utilized. From the foot of the hills to the St. Lawrence the slope of the river is moderate and rock outcrop not frequent, consequently favorable sites for power development are scarce. According to report of the State Water Supply Commission for 1910, the present limit of profitable development through this low country, except as increased by regulation of stream flow, has probably been reached in the existing plants. A detailed description, showing all power developments and future possible developments, is given in the 1910 report of the State Water Supply Commission.

ST. REGIS RIVER AT BRASHER CENTER, N. Y.

This station, which is located in the village of Brasher Center, 5 miles downstream from Brasher Falls, and about 12 miles above the mouth of the river, was established August 22, 1910, in cooperation with the New York State Water Supply Commission.

A chain gage is located on the downstream side of the bridge, over the right-hand channel.

Low-water measurements have been made by wading about 500 feet above the bridge; high-water measurements are made from the bridge. A rating table is not developed as yet and only discharge measurements and gage heights are published.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission.

Discharge measurements of St. Regis River at Brasher Center, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec. ft.*
July 25	C. C. Covert	160	196	[a] 19.36	176
Aug. 20[b]	W. G. Hoyt	216	359	4.48	505

[a] Distance to water surface from reference point on first bridge above Helena.
[b] Measurement made at wading section, 200 feet upstream from gage.

[1] State Water Supply Commission.

Daily gage height, in feet, of St. Regis River at Brasher Center, N. Y., for 1910.

[George Myers, observer.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.12	4.12	4.85	4.42	16	.....	4.25	4.25	4.78	5.50
2	.....	4.10	4.10	4.85	4.58	17	.....	4.22	4.35	4.70	5.62
3	.....	4.22	4.10	4.72	4.55	18	.....	4.20	4.38	4.55	.....
4	.....	4.18	4.25	4.78	4.70	19	.....	4.20	4.30	4.62	.....
5	.....	4.16	4.32	4.78	4.80	20	.....	4.10	4.35	4.65	.....
6	.....	4.22	4.40	4.88	4.68	21	.....	4.12	4.25	4.48	.....
7	.....	5.12	5.18	4.98	5.20	22	4.25	4.12	4.10	4.52	.....
8	.....	5.22	5.50	4.88	5.20	23	4.16	4.16	4.12	4.50	.....
9	.....	4.96	5.40	4.82	5.85	24	4.05	4.10	4.25	4.42	.....
10	.....	4.70	5.22	4.78	6.00	25	4.11	4.12	4.60	4.60	.....
11	.....	4.55	4.95	5.05	6.05	26	4.15	4.10	5.25	4.62	.....
12	.....	4.41	4.75	5.08	6.05	27	4.25	4.12	5.45	4.62	.....
13	.....	4.32	4.50	4.98	5.98	28	4.02	4.18	5.50	4.62	.....
14	.....	4.25	4.35	4.88	5.85	29	3.95	4.20	5.40	4.55	.....
15	.....	4.22	4.35	4.75	5.35	30	3.50	4.12	5.35	4.48	.....
						31	4.05	.....	5.05	.....	.....

NOTE.—Ice present Dec. 7–31.

RICHELIEU RIVER BASIN.

GENERAL FEATURES.

Richelieu River, the outlet of Lake Champlain, emerges from the lake at Rouse Point and flows northward to the St. Lawrence.

Lake Champlain occupies a long and narrow valley, extending in a north-south direction and forming a part of the boundary between New York and Vermont. The elevation of the lake is about 95 feet above tide, and the water-surface area is 436 square miles.

The drainage basin is irregular in form, being about 75 miles wide from a point opposite Middlebury, Vt., northward to the outlet of the lake at Rouse Point, on the international boundary. South of Middlebury the average width of the basin is about 35 miles, and the lake itself is very narrow, forming virtually a drowned river.

The tributary region is rugged and mountainous, covered with little depth of soil except in the stream valleys. The drainage is received almost entirely through large tributaries, there being little direct coast drainage into the lake. The total drainage area at the mouth of the lake is about 7,867 square miles (including lake surface).

LAKE CHAMPLAIN AT BURLINGTON, VT.

This station is located on the south side of the roadway leading to the docks of the Champlain Transportation Co., of Burlington, Vt., at a point about 80 feet from the roadway at the foot of King Street. Readings have been obtained since May 1, 1907.

A comparison of gage readings on calm days during 1907 and 1908, made under the direction of Prof. A. D. Butterfield, formerly of the University of Vermont, indicates that the zeros of the gages at Fort Montgomery and at Burlington are at substantially the same elevation, namely, 92.50 feet above mean sea level. The gage readings at Burlington during 1910, as published in the following

table, were taken and furnished through the courtesy of Mr. D. A. Loomis, general manager of the Champlain Transportation Co.

Daily gage height, in feet, of Lake Champlain at Burlington, Vt., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	5.40	.....	3.80	3.15	1.90	1.40	1.00	1.20	1.35
2	.....	a 1.80	2.55	5.50	.....	3.80	3.10	1.85	.....	.....	1.20	1.35
3	.....	.....	2.97	.....	4.30	3.70	.....	1.80	.....	1.00	1.20	1.37
4	.....	.....	.....	5.45	4.40	3.65	.....	1.80	.....	1.00	.....	.....
5	.....	.....	.....	5.40	4.50	.....	2.95	1.80	1.33	1.00	1.25	1.37
6	.....	.....	.....	5.30	4.50	3.60	2.90	1.80	1.30	1.00	.....	1.35
7	.....	.....	.....	5.38	4.50	3.60	2.85	1.80	1.25	1.05	.....	1.35
8	.....	a 1.80	.....	5.40	.....	3.78	2.80	1.80	1.30	1.10	1.40	1.33
9	.....	.....	4.53	5.40	4.50	3.85	2.70	.....	.....	.....	1.40	1.30
10	.....	.....	4.63	.....	4.40	3.90	.....	1.75	1.40	1.15	1.47	.....
11	.....	.....	.....	5.38	4.00	3.90	2.65	1.75	1.40	1.15	1.40	.....
12	.....	.....	4.70	5.35	4.35	.....	2.60	1.70	1.40	1.15	1.45	.....
13	.....	.....	.....	5.30	4.30	3.85	2.50	1.70	1.35	1.17	.....	.....
14	a 0.71	1.80	4.78	5.20	4.28	3.85	2.45	.....	1.33	1.17	1.45	.....
15	.....	.....	4.80	5.10	.....	3.80	2.40	1.70	1.30	1.20	1.45	.....
16	.....	.....	4.75	5.05	4.05	3.75	2.40	1.70	1.30	1.20	1.45	.....
17	.....	.....	4.70	.....	4.00	3.75	.....	1.70	1.30	1.15	1.45	.....
18	.....	.....	4.70	4.85	3.90	3.70	2.40	1.65	.....	1.15	1.45	.....
19	a .70	.....	4.55	4.85	3.85	.....	2.35	1.65	1.25	1.10	1.43	.....
20	.....	.....	.....	4.85	3.85	3.65	2.30	1.65	1.25	1.10	.....	.....
21	.....	1.90	4.60	4.80	3.80	3.60	2.25	.....	1.20	1.10	1.40	.....
22	.....	.....	4.68	4.75	.....	3.55	.....	1.65	1.20	1.10	1.40	.....
23	.....	.....	4.65	4.70	3.75	3.50	2.15	1.60	.....	.....	1.40	.....
24	1.15	.....	4.65	.....	3.75	3.45	.....	1.60	1.10	1.10	1.35	.....
25	1.40	.....	4.75	4.60	3.60	3.40	2.10	1.60	.....	1.10	1.35	.....
26	.....	.....	4.95	4.52	3.70	.....	2.00	1.35	1.05	.....	1.35	.....
27	.....	.....	.....	4.45	3.75	3.40	1.95	1.35	.....	1.15	.....	1.25
28	1.60	2.00	5.15	4.45	3.75	3.40	1.95	.....	1.05	.....	1.35	.....
29	.....	.....	5.20	4.40	.....	.....	1.95	1.35	1.05	1.20	1.35	.....
30	.....	.....	5.30	.....	.....	3.15	1.95	1.40	1.05	.....	1.35	.....
31	.....	.....	5.25	.....	3.80	.....	.....	1.40	.....	1.20	1.35	.....

a Surface of ice.

Breaking up of ice in Lake Champlain.

Year.	Ice broke up.	Steamers commenced running between Burlington and Plattsburg.	Year.	Ice broke up.	Steamers commenced running between Burlington and Plattsburg.
1897	Apr. 7	Apr. 10	1905	Apr. 14	Apr. 17
1898	Mar. 25	Mar. 26	1906	...do....	Do.
1899	Apr. 19	Apr. 20	1907	Apr. 16	Apr. 18
1900	Apr. 20	Apr. 21	1908	Apr. 14	Apr. 20
1901	Apr. 15	Apr. 17	1909	Apr. 13	Apr. 19
1902	Apr. 5	Apr. 7	1910	Mar. 28	Apr. 11
1903	Mar. 17	Mar. 25	1911	Apr. 24	Apr. 24
1904	Apr. 18	Apr. 19			

RICHELIEU RIVER AT FORT MONTGOMERY, N. Y.

This station is located in the fort, about one-half mile from the head of Richelieu River, at the outlet of Lake Champlain at Rouse Point, N. Y., where a record of gage heights has been kept by the United States Corps of Engineers since 1875. Through the courtesy of Maj. Edward Burr the daily gage readings are reported weekly to the United States Geological Survey.

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The entire surface of Lake Champlain freezes over nearly every winter, and the freezing may affect the discharge.

The elevation of gage zero at Fort Montgomery is 92.50 feet above mean sea level, according to the adjustment in 1906 of mean sea datum in this vicinity by the topographic branch of the United States Geological Survey. High-water level is at elevation 101.6 feet, and on November 13, 1908, an elevation of 91.9 feet was recorded at Fort Montgomery, probably the lowest on record.

The daily discharge of the lake has been determined from observations of the depth and discharge over the Chambly dam, 35 miles below the head of Richelieu River, made in 1898 by the United States Board on Deep Waterways. A rating table has been derived from the observations at the Chambly dam and the gage readings taken at Rouse Point. The area tributary to the river between Rouse Point and Chambly is 310 square miles, making the total drainage basin above Chambly 8,177 square miles.[1]

Estimates of monthly discharge are withheld pending the verification of the rating curve previously used to determine the discharge at this point.

All gage heights previously published, including those for 1910, have been referred to the gage zero instead of to sea level.

Information in regard to this station is contained in the reports of the New York State engineer and surveyor.

Daily gage height, in feet, of Richelieu River at Fort Montgomery, N. Y., for 1910.

[William McComb, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.5	1.45	2.1	5.3	4.2	3.6	3.05	1.8	1.2	1.3	1.2	1.25
2	.45	1.5	2.4	5.35	4.3	3.65	3.0	1.75	1.2	.9	1.4	1.3
3	.45	1.5	2.75	5.35	4.1	3.6	2.95	1.8	1.45	1.0	1.0	1.3
4	.4	1.55	2.95	5.45	4.15	3.5	2.85	1.85	1.15	1.45	.9	1.3
5	.45	1.5	3.15	5.35	4.4	3.5	2.9	1.75	1.2	1.1	1.1	1.2
6	.45	1.5	3.35	5.35	4.45	3.55	2.85	1.75	1.25	1.25	1.2	1.25
7	.4	1.6	3.65	5.25	4.5	3.55	2.85	1.7	1.25	1.0	1.3	1.25
8	.45	1.65	3.9	5.2	4.4	3.6	2.75	1.7	1.3	1.1	1.25	1.3
9	.45	1.65	4.1	5.25	4.4	3.75	2.7	1.75	1.3	1.2	1.3	1.2
10	.4	1.6	4.25	5.2	4.35	3.8	2.65	1.9	1.25	1.05	1.3	1.2
11	.4	1.55	4.35	5.2	4.3	3.8	2.6	1.7	1.3	1.1	1.35	1.2
12	.05	1.55	4.5	5.15	4.25	3.85	2.55	1.7	1.35	.85	1.3	1.1
13	.4	1.5	.....	5.15	4.2	3.8	2.55	1.7	1.15	1.0	1.35	1.1
14	.4	1.5	.....	5.15	4.1	3.75	2.5	1.65	1.15	1.0	1.3	1.2
15	.4	1.55	.....	5.0	4.05	3.75	2.4	1.65	1.25	1.0	1.3	1.05
16	.45	1.55	.....	4.95	4.05	3.65	2.3	1.6	1.2	.9	1.25	1.1
17	.45	1.55	4.5	5.25	4.0	3.7	2.25	1.65	1.15	1.0	1.25	1.2
18	.45	1.5	4.45	4.95	4.1	3.65	2.15	1.75	1.15	1.05	1.3	1.1
19	.4	1.6	.....	4.8	3.8	3.6	2.15	1.5	1.1	1.1	1.25	1.15
20	.4	1.55	.....	4.8	3.7	3.55	2.1	1.5	1.15	1.0	1.3	1.15
21	.45	1.6	.....	4.7	3.7	3.55	2.3	1.55	1.1	.9	1.35	1.05
22	.5	1.65	.....	4.65	3.65	3.5	2.25	1.6	1.05	1.4	1.25	1.1
23	.8	1.7	.....	4.6	3.7	3.4	2.05	1.7	1.15	.9	1.3	1.25
24	1.0	1.7	.....	4.55	3.7	3.35	2.05	1.6	1.45	.9	1.4	1.1
25	1.15	1.7	4.55	4.5	3.6	3.35	2.05	1.6	1.25	.95	1.25	1.05
26	1.25	1.75	4.7	4.5	3.6	3.3	1.95	1.45	1.15	.9	1.2	1.15
27	1.35	1.75	4.9	4.4	3.6	3.3	1.95	1.45	1.05	1.5	1.15	1.2
28	1.35	1.85	5.3	4.25	3.65	3.2	1.9	1.45	1.1	.95	1.2	1.2
29	1.35	.....	5.15	4.3	3.65	3.15	1.9	1.25	1.05	1.0	1.25	1.15
30	1.5	.....	5.2	4.6	3.65	3.1	1.95	1.25	1.25	1.05	1.2	1.25
31	1.45	.....	.....	.....	3.6	.....	1.8	1.5	.....	1.2	.....	1.3

[1] Rept. State Engineer and Surveyor of New York for 1910.

SARANAC RIVER BASIN.

GENERAL FEATURES.

Saranac River rises in the lakes in southeastern Franklin County, N. Y., and flows northeastward to a point near Cadyville and thence eastward into Lake Champlain at Plattsburg. The basin ranges in width from 10 to less than 25 miles and is about 60 miles long, the total drainage area comprising about 630 square miles. The southern boundary of the basin is the Ampersand Mountain range and the stream drains the north slope of the most elevated region of the State of New York.

About 16.2 per cent of the upper drainage is water surface. Owing to its somewhat equalized flow and rapid fall the stream presents many opportunities for power development. The mean annual precipitation is about 35 inches, and the winters are usually severe.

SARANAC RIVER NEAR PLATTSBURG, N. Y.

This station, which is located at the Lozier dam of the Plattsburgh Gas & Electric Co., about 6 miles above Plattsburg, was established March 27, 1903.

The record includes the flow over a spillway crest 171.75 feet in length, the discharge through two 5-foot waste gates when open, and the discharge through four 33-inch Victor turbines controlled by automatic governors. The records are furnished by Herbert A. Stutchbury, superintendent. Experiments have been made at Cornell University hydraulic laboratory on a model of the ogee section of the dam, from which coefficients have been derived for the calculation of the discharge over the dam.

The elevation of the zeros of both the spillway gage and the tailrace gage have remained the same during the maintenance of the station.

Tests made at this plant indicate that past computations of discharge at low stages are 20 per cent or more too low. The determinations of daily discharges are withheld pending further tests.

Information in regard to this station is contained in the reports of the New York State engineer and surveyor.

AUSABLE RIVER BASIN.

GENERAL FEATURES.

Ausable River is formed by the junction of its East and West branches, which head in the northwestern part of Essex County. The East Branch flows from upper Ausable Lake, at an elevation of 1,990 feet above sea level; the West Branch is formed by several small streams which lie in the valley to the west and north of East Branch. Both branches flow north and east to their junction in the

village of Ausable Forks, from which point the river flows northeast, entering Lake Champlain about 10 miles south of Plattsburg, opposite and slightly north of the city of Burlington.

Throughout the entire course the river is fed by small mountain streams, which enter at nearly right angles from the mountains on either side. There are few lakes in this drainage basin to regulate the flow and, owing to the great differences of elevation throughout the area, the stream has what is called a flashy discharge, its fluctuations being large and rapid.

Owing to the fact that this basin lies on the eastern slope of the Adirondack Mountains, the average rainfall is less than for those basins whose streams rise in the western and southern slopes, the mean yearly precipitation being about 32 inches.

About 6,000 water horsepower is developed at the present time, principally on the West Branch.[1]

AUSABLE RIVER AT AUSABLE FORKS, N. Y.

This station, which is located in the village of Ausable Forks, about 15 miles above the mouth of the river, immediately below the junction of the East and West branches, was established August 27, 1910, in cooperation with the New York State Water Supply Commission.

A standard chain gage is fastened to a cantilever arm on the right hand bank, about 40 feet below the confluence of the East and West branches, in the village of Ausable Forks.

Measurements during this year have been made farther down stream by wading. On December 7, 1910, there was installed, 2 miles below the gage, a cable from which future measurements will be made.

The gage heights published below are slightly affected by the operation of pulp mills above the station.

Discharge measurements of Ausable River at Ausable Forks, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 17	W. G. Hoyt	207	314	3.77	*a* 327
Dec. 9	Covert & Shuttleworth	182	313	3.85	*b* 271

a Measurement made at wading section.
b Measurement made under partial ice cover at cable station.

[1] See Fifth Ann. Rept. New York State Water Supply Comm., pp. 88, 147, 267.

Daily gage height, in feet, of Ausable River at Ausable Forks, N. Y., for 1910.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.60	3.66	3.78	3.72	16		3.61	3.62	3.83	3.97
2		3.60	3.66	3.72	3.72	17	3.76	3.64	3.62	3.72	3.90
3		3.61	3.83	3.76	3.68	18	3.67	3.61	3.66	3.70	3.88
4		3.68	3.74	3.87	3.70	19	3.74	3.62	3.62	3.80	4.02
5		3.82	3.74	4.08	3.73	20	3.68	3.59	3.64	3.69	3.90
6		4.38	3.78	4.22	3.73	21	3.64	3.61	3.61	3.84	3.77
7		4.09	3.96	4.12	3.86	22	3.64	3.60	3.62	3.80	3.88
8		3.66	3.90	3.82	3.80	23	3.62	3.62	3.64	3.76	3.86
9		3.66	3.80	3.74	3.72	24	3.62	3.60	3.68	3.73	3.82
10		3.72	3.83	3.82	3.83	25	3.62	3.56	3.72	3.77	3.88
11		3.56	3.93	3.82	3.73	26	3.62	3.58	3.66	3.74	4.12
12		3.72	3.82	3.90	3.86	27	3.59	3.70	3.80	3.68	3.84
13		3.62	3.72	3.78	3.87	28	3.59	3.69	4.41	3.74	3.74
14		3.62	3.74	3.77	3.96	29	3.62	3.67	4.13	3.68	3.78
15		3.60	3.68	3.76	4.02	30	3.58	3.70	3.80	3.73	3.78
						31	3.56		3.76		4.14

NOTE.—No information is available regarding the effect of ice; it is probable that the relation of gage height to discharge was more or less affected by ice during the greater part of December.

WINOOSKI RIVER BASIN.

GENERAL FEATURES.

Winooski River, which is one of the most important of the Vermont rivers draining into Lake Champlain, has its source in the Green Mountains in the east-central part of the State. The river is formed at Marshfield by several branches which start from many small ponds; it then flows in a general southwesterly direction as far as Montpelier, at which place it has received the drainage from Kingsbury Brook, Stevens Branch, Worcester Branch, Dog River, and several less important tributaries; from Montpelier its general course is northwestward to Lake Champlain, which it enters near Burlington, having been joined near Middlesex by Mad River and at Waterbury by Waterbury River. From mouth to source the river is about 60 miles long and its drainage area comprises about 995 square miles. The ratio of lake surface to the entire area is small.

Along the river are several important power sites, some of which are already developed. The storage on the river, artificial or natural, is small, but it is believed that opportunities for development are fairly good.

In the upper part of the basin the country is mountainous and fairly well forested. Below Montpelier the slope of the river in general is rather flat.

The mean annual rainfall for this region is about 33 inches; at Burlington for a period of eighty-one years the mean is 32.68 inches. During the winter months the precipitation is generally the least of the year. The average depth of snow is about 24 inches, while the average temperature ranges through the year from about 66° to 15° F.

WINOOSKI RIVER ABOVE STEVENS BRANCH, NEAR MONTPELIER, VT.

This station, which is located about 3 miles above Montpelier at the plant of the Corry-Deavitt & Frost Electric Co., was established May 18, 1909, in cooperation with the State of Vermont.

The station is above the several large tributaries of Winooski River which enter in the vicinity of Montpelier.

The staff gage is bolted to a bowlder on the right bank about 100 feet below the power plant. No change has been made in the gage datum.

Discharge measurements are made from the lower railroad bridge about half a mile below the gage.

Daily fluctuations in the stage of the river are not usually great, as the power plant is operated throughout the twenty-four hours.

The flow during the winter is considerably affected by anchor ice.

Conditions for obtaining accurate discharge data are fair. The relation of gage heights to discharge is fairly well determined.

The gage heights at this station were furnished by the Corry-Deavitt & Frost Electric Co.

Accurate computation of the diurnal fluctuation of discharge caused by the operation of the mills above the station has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since no gage heights recorded at this station are true indices of the daily discharge.

Discharge measurements of Winooski River above Stevens Branch, near Montpelier, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 22	T. W. Noreross	70.5	230	3.14	274
Oct. 26	C. C. Covert	68	193	2.8	223

WINOOSKI RIVER AT MONTPELIER, VT.

This station, which is located at the covered wooden highway bridge near the Central Vermont Railroad station in Montpelier, was established in cooperation with the State of Vermont May 19, 1909. It is near the plant of the Colton Manufacturing Co., through whose courtesy the gage readings are obtained.

Worcester and Stevens branches enter above the gaging station, and Dog River enters just below.

Discharge measurements are made from a footbridge about half a mile below the chain gage which is located on the highway bridge. As the flow through the wheels is controlled by automatic governors and varies considerably throughout the day, many computations are necessary in order to obtain each daily discharge. Anchor ice during the winter sometimes affects the relation between gage height and discharge.

The gage datum has remained unchanged throughout the period of maintenance of this station. The discharge curve is well defined.

Special night readings of the gage show that there is a drop in stage of about 0.5 foot each night due to storage.

Accurate computation of the diurnal fluctuation of discharge caused by the operation of the mills above the station has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since no gage heights recorded at this station are true indices of the daily discharge.

Discharge measurements of Winooski River at Montpelier, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 22	T. W. Norcross	181	447	4.67	466
23	do	181	526	5.06	676
July 24	Brett and Butterfield	177	261	3.72	79
Oct. 26	C. C. Covert	182	501	4.70	589

WINOOSKI RIVER AT RICHMOND, VT.

This station, which is located at the steel highway bridge about one-fourth mile south of the railroad station at Richmond, Vt., was established June 25, 1903, discontinued May 1, 1907, reestablished July 8, 1910, and maintained temporarily until October 31, 1910, when it was again discontinued.

The datum of the chain gage has remained the same during the periods of maintenance of the station.

During the winter months the river is affected by ice.

Conditions for obtaining accurate discharge measurements are fairly good. Gage heights are more or less affected by controlled flow, but owing to the size of the stream the fluctuations are not sufficient to materially affect the accuracy of the results here published.

Discharge measurements of Winooski River at Richmond, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 9	Brett and Butterfield	138	186	4.31	408
Aug. 29	G. M. Brett	93	130	3.80	148

NOTE.—Measurements made by wading about 1,500 feet above the bridge.

Daily gage height, in feet, of Winooski River at Richmond, Vt., for 1910.

Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.
1		4.2	4.05	4.5	16	4.15	4.2	4.2	4.1
2		4.2	4.0	5.2	17	3.85	4.25	4.2	4.1
3		4.15	4.05	5.3	18	4.0	4.3	4.05	4.3
4		4.25	4.1	4.8	19	4.1	4.3	4.05	4.35
5		4.85	4.3	4.6	20	4.15	4.25	4.05	4.2
6		4.95	5.5	4.7	21	4.05	4.1	4.15	4.3
7		5.05	6.1	4.9	22	4.15	4.25	4.15	4.25
8		4.85	5.45	4.7	23	4.2	4.15	4.1	4.15
9		4.65	4.95	4.55	24	4.0	4.1	4.05	4.6
10		4.4	4.45	4.65	25	4.2	4.2	3.95	4.65
11	4.2	4.65	4.15	4.75	26	4.1	4.15	4.15	5.2
12	4.3	4.65	4.2	4.55	27	4.05	4.0	4.25	5.4
13	4.3	4.55	4.25	4.5	28	5.05	3.9	6.55	5.68
14	4.3	4.25	4.2	4.55	29	4.8	3.95	6.0	5.3
15	4.2	4.25	4.25	4.45	30	4.6	3.95	4.95	5.0
					31	4.15	4.0		4.9

Daily discharge, in second-feet, of Winooski River at Richmond, Vt., for 1910.

Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.
1		340	260	540	16	312	340	340	285
2		340	235	1,200	17	170	370	340	285
3		312	260	1,300	18	235	400	260	400
4		370	285	800	19	285	400	260	435
5		850	400	620	20	312	370	260	340
6		950	1,520	710	21	260	285	312	400
7		1,050	2,220	900	22	312	370	312	370
8		850	1,460	710	23	340	312	285	312
9		665	950	580	24	235	285	260	620
10		470	505	665	25	340	340	212	665
11	340	665	312	755	26	285	312	312	1,200
12	400	665	340	580	27	260	235	370	1,410
13	400	580	370	540	28	1,050	190	2,840	1,720
14	400	370	340	580	29	800	212	2,090	1,300
15	340	370	370	505	30	620	212	950	1,000
					31	312	235		900

NOTE.—Daily discharge determined from a fairly well defined discharge rating curve.

Monthly discharge of Winooski River at Richmond, Vt., for 1910.

[Drainage area, 977 [a] square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
July 11–31	1,050	170	381	0.390	.30	B.
August	1,050	190	442	.452	.52	B.
September	2,840	212	641	.656	.73	B.
October	1,720	285	730	.747	.86	B.

[a] The measurement of drainage area has been revised since the publication of the data for 1903–1907.

STEVENS BRANCH OF WINOOSKI RIVER NEAR MONTPELIER, VT.

This station, which is located near the private covered wooden highway bridge on the Marvin farm, about 2 miles from Montgomery, on the road to Barre, and one-quarter mile above the junction of the Stevens Branch with Winooski River, was established July 5, 1910, in cooperation with the State of Vermont.

A 6-foot staff gage was attached vertically to a stump on the left bank, 60 feet below the bridge.

Discharge measurements are made by wading at the gage.

Conditions for obtaining low-water measurements at this station are good.

There is uncertainty regarding storage effect of mills on the daily gage height.

Accurate computation of the diurnal fluctuation of discharge has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since the gage heights recorded at this station may not be true indices of the daily discharge.

Discharge measurements of Stevens Branch of Winooski River near Montpelier, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 5	G. M. Brett	51.5	69.4	1.79	77
23	Brett and Butterfield	48	45.1	1.38	14.3
Aug. 10	G. M. Brett	52	69.9	1.75	64.3
23	do	51	61.1	1.63	46.2

WORCESTER BRANCH OF WINOOSKI RIVER AT MONTPELIER, VT.

This station, which is located a short distance below the Lane Manufacturing Co.'s plant at Montpelier and near the junction of Worcester Branch with the main river, was established May 15, 1909, in cooperation with the State of Vermont. This stream is one of the important tributaries of the Winooski.

The vertical staff gage is fastened to a stone wall and tree about 100 feet below the plant. The gage datum has remained unchanged.

Discharge measurements are made from a steel highway bridge about 300 feet below the staff gage. The conditions under which discharge measurements are made are good.

The gage heights are materially affected by ice during the winter.

The discharge rating curve is well developed. The gage heights are read under the direction of the Lane Manufacturing Co., through whose courtesy they are furnished.

During low stages no water flows over the dam, and there is only a little flow during the night when the power plant is shut down. During the 10 hours that the plant is in operation all water passes through the wheels.

Accurate computation of the diurnal fluctuation of discharge caused by the operation of the mills above the station has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since no gage heights recorded at this station are true indices of the daily discharge.

Discharge measurements of Worcester Branch of Winooski River at Montpelier, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 21	T. W. Norcross	63	110	1.76	126
21	do	63	104	1.72	116
Oct. 26	C. C. Covert	66	170	2.20	201

DOG RIVER AT NORTHFIELD, VT.

This station, which was established May 14, 1909, in cooperation with the State of Vermont, was originally located at the wooden highway bridge, designated as the lower bridge, about 600 feet below the dam of the Rabidou Lumber Co. and about three-fourths of a mile from the railroad station at Northfield.

Discharge measurements were made from the bridge at which the staff gage is located and also from the highway bridge near Norwich University, designated as upper bridge. The datum of the original gage remained unchanged.

On account of the close proximity of the station to the lumber company's dam, the gage-height record was greatly affected by control of the flow by the company. Accordingly the lower bridge station was discontinued August 28, 1910, and a new station (upper bridge) was established August 23, 1910, at the highway bridge near the Norwich University grounds, approximately 1 mile above the original location. Measuring conditions at the present location are only fair. The staff gage is attached to the downstream side of left abutment. There is no backwater from the lumber company's dam at the new location.

Although the effect of controlled flow at the new location is not so marked as at the original station, the daily gage heights are still subject to much error caused by operations at dams higher up the

river. Accordingly no estimates of discharge have been attempted for 1910.

Both stations are much affected by backwater from ice.

Accurate computation of the diurnal fluctuation of discharge caused by the operation of the mills above the station has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since no gage heights recorded at this station are true indices of the daily discharge.

With the exception of the computations of results and a few discharge measurements, all the data at this station have been obtained by the students of Norwich University, under the direction of Prof. C. S. Carleton.

Discharge measurements of Dog River at Northfield, Vt., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 19	Norwich University students	33.8	127	2.53	164
27	do	32.5	102	1.88	88.6
June 24	D. M. Wood	33	85.9	1.18	22.0
1910.					
Aug. 9	C. M. Brett	15	13.5	1.03	12.9
24	do	15.5	12.3	1.00	12.0

NOTE.—Gage heights refer to upper gage.

DOG RIVER NEAR MONTPELIER JUNCTION, VT.

This station, which is located at the covered wooden highway bridge, about half a mile above the mouth of the river, was established July 6, 1910, in cooperation with the State of Vermont.

A 6-foot wooden staff gage was attached vertically to the downstream end of the right-hand abutment. Discharge measurements are made about 100 feet below the gage by wading. Conditions for obtaining low-water measurements are good at this station.

There is uncertainty regarding the effect of mill storage on the fluctuation of the daily gage height.

Accurate computation of the diurnal fluctuation of discharge has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since the

gage heights recorded at this station may not be true indices of the daily discharge.

Discharge measurements of Dog River near Montpelier Junction, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1910.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 6	G. M. Brett	28.5	32.7	1.65	36.5
24	Brett and Butterfield	27.5	27.5	1.42	14.7
Aug. 10	G. M. Brett	27	26.6	1.42	12.2
11	.....do	28	30.0	1.59	28.2

MAD RIVER NEAR MORETOWN, VT.

This station, which is located at the covered wooden highway bridge, known locally as Armstrong's Bridge, about 4 miles from Middlesex on the road to Moretown, was established July 6, 1910, in cooperation with the State of Vermont.

A 6-foot wooden staff gage was attached vertically to the downstream end of the left-hand abutment. Discharge measurements are made by wading about 1,000 feet below the bridge. The discharge rating curve is well defined between gage heights 1.4 and 1.9 feet.

There is uncertainty regarding the effect of control flow on the daily gage heights.

Accurate computation of the diurnal fluctuation of discharge has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since the gage heights recorded at this station may not be true indices of the daily discharge.

Discharge measurements of Mad River near Moretown, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 6	G. M. Brett	54.5	38.6	1.75	49.7
Aug. 8	.....do	67.8	102	1.92	63.1
8	.....do	67.8	102	1.92	68.9
22	.....do	53	69.9	1.60	20.1
28	A. D. Butterfield	52	21.4	1.48	13.6

LITTLE RIVER NEAR WATERBURY, VT.

This station, which is located near the covered wooden highway bridge, known locally as Barber's Bridge, about 3½ miles above Waterbury, on the road to Stowe, was established July 7, 1910, in cooperation with the State of Vermont.

A 6-foot wooden staff gage is attached to the right bank, about 75 feet below the bridge. Discharge measurements are made by wading about 100 feet above the bridge. Conditions at this station are good for low-water measurements.

The daily gage heights for this station are probably more or less affected by mill storage.

Accurate computation of the diurnal fluctuation of discharge has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since the gage heights recorded at this station may not be true indices of the daily discharge.

Discharge measurements of Little River near Waterbury, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 7	G. M. Brett	28.5	57.4	4.32	51.6
15	do	28.5	41.6	4.24	40.3
Aug. 17	A. D. Butterfield	34	48.5	4.42	63.9

HUNTINGTON RIVER AT JONESVILLE, VT.

This station, which is located at Palmer's mill, three-fourths of a mile from Jonesville railroad station, was established July 16, 1910, in cooperation with the State of Vermont.

The staff gage is nailed to the cribwork at the intake to the wheels of Palmer's mill.

Discharge measurements are made by wading 200 feet above the mouth of the river, three-fourths of a mile below the gage. Insufficient data have been obtained to define the relation of gage heights to discharge.

The gage heights are furnished through the courtesy of G. W. Palmer.

The station is above and within the influence of the dam. The dam leaks badly and the pond above is filled with sediment and it can only be used for power purposes at extreme high water. The influence of this dam on the gage-height record is slight.

Accurate computation of the diurnal fluctuation of discharge has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage

heights for 1910 are withheld pending this investigation, since the gage heights recorded at this station may not be true indices of the daily discharge.

Discharge measurements of Huntington River at Jonesville, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 16	G. M. Brett	27	11.2	3.25	12.0
Aug. 29	do	20	12.0	3.15	6.7

LAMOILLE RIVER BASIN.

GENERAL FEATURES.

Lamoille River has its source in several ponds, the largest of which is Caspian Lake, in the Green Mountain district of north-central Vermont, flows in a general westerly direction, and enters Lake Champlain near Champlain. Its most important tributaries are Alder and Wild brooks, Ginon River, North Branch, and Brown River.

Considerable areas in the upper part of the basin are in forest. Lakes are numerous and some storage has already been developed, but opportunities for improvement are many. Several power sites are yet undeveloped.

The mean annual rainfall in this region is probably about 34 inches. The general temperature changes and the winter conditions are similar to those in the Winooski basin. (See p. 101.)

LAMOILLE RIVER NEAR MORRISVILLE, VT.

This station, which is located at the Morrisville municipal plant, about 1½ miles below Morrisville, Vt., was established July 28, 1909, in cooperation with the State of Vermont.

Above the station the stream receives many tributaries, on some of which power plants are already installed; below the station no large tributary enters for about 8 miles, when Ginon River comes in at Johnson.

The chain gage, which is placed on the highway bridge just below the municipal plant, serves as an index of the total flow of the river and the height of the water in the tailrace. The datum of the gage has not been changed during the maintenance of this station. The gage heights are furnished through the courtesy of the Morrisville municipal plant.

Discharge measurements are made by wading at a ford about half a mile below the station and from the highway bridge.

During the winter months the flow is only slightly affected by ice.

The flow at the station is well regulated by about 550 acres of pond area, and the plant can be run throughout the year without auxiliary power. Extensive improvements are being made at the electric plant. On their completion it is expected that the flow of the river will be computed by measuring the flow over the dam and through the wheels. The dam is of concrete, of ogee section, and is 188 feet long. The water for the wheels is taken from the pond through about 1,200 feet of steel pipe to the power house, where a large standpipe with overflow is installed. The present equipment consists of one pair of 33-inch Victor turbines, hydraulically governed and operating under about a 40-foot head. Power is supplied chiefly for municipal lighting, but some is sold for industrial uses.

This station was replaced July 24, 1910, by a new station at Johnson, Vt.

Accurate computation of the diurnal fluctuation of discharge caused by the operation of the mills above the station has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since no gage heights recorded at this station are true indices of the daily discharge.

Discharge measurements of Lamoille River near Morrisville, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 6[a]	D. M. Wood	58	190	2.40	146
Mar. 27	T. W. Norcross	96	459	5.71	1,680
Apr. 19	.....do	80	326	3.76	510

[a] Measurement made under ice cover.

LAMOILLE RIVER AT JOHNSON, VT.

This station, which is located at a covered highway bridge in the town of Johnson, on the road to the railroad station, was established July 14, 1910, in cooperation with the State of Vermont to continue records formerly taken on this river in the vicinity of Morrisville.

The river bed consists of cobblestone, is permanent, and is regular in cross section. The velocity is uniform.

A chain gage, read twice daily, is attached to the upstream side of the bridge.

Measurements are made both by wading and from the bridge.

The rating table is not accurately developed for 1910.

Accurate computation of the diurnal fluctuation of discharge caused by the operation of the mills above the station has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since no gage heights recorded at this station are true indices of the daily discharge.

Discharge measurements of Lamoille River at Johnson, Vt., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 28[a]	D. M. Wood	82	142	2.51	128
1910.					
Mar. 27[b]	T. W. Norcross	95	424	5.45	1,640
Apr. 19	do	89	261	3.69	642
July 14	C. M. Brett	84	150	2.38	193
Aug. 20	do	82	169	2.68	226

[a] Conditions unfavorable for good measurement.
[b] Measurement partly made by subsurface method, using coefficient of 0.85.

MISSISQUOI RIVER BASIN.

GENERAL FEATURES.

Missisquoi River drains the northern part of Vermont and the southern parts of the Missisquoi and Brome districts, in the Province of Quebec, Canada. The river is formed by the junction of two branches, one rising in the mountainous region near Lowell, in the southwestern part of Orleans County, and flowing in a general northerly direction, the other rising near Bolton, Brome, and taking a southerly course. The two unite at Mansonville, in Brome, and the river takes a general westerly course to Lake Champlain, which it enters at Missisquoi Bay. From North Troy to Richford it lies in Canada. The important tributaries of the Missisquoi are the North Branch, Trout River, Tylers Branch, and Black Creek.

The mean annual rainfall in this region is probably about 40 inches. The driest year since 1892, according to observations made at Enosburg Falls, was 1908, when the precipitation amounted to 31.90 inches; the wettest was 1901, with 52.30 inches. The winters are severe. The snowfall has an average depth of about 26 inches, and the average temperature for January and February is 16° F.

Throughout its course the Missisquoi flows alternately through long stretches having gentle slope and shorter sections having much greater fall. The power sites along the river are fairly numerous, but storage is not well developed.

MISSISQUOI RIVER AT RICHFORD, VT.

This station, which is located just below the steel highway bridge in Richford, Vt., was established May 24, 1909, in cooperation with the State of Vermont. North Branch enters the main river a little below the station, but the tributaries above are small.

Three gages were used—a chain gage, which is located just below the mill of the Sweat-Comings Manufacturing Co., and two staff gages, which are attached to rocks in the river, one of which was washed away January 23, 1910, and the other September 22, 1910. All readings from the staff gages are referred to the chain gage. The readings were unreliable after September 10, 1910.

Discharge measurements were made by wading a short distance below the gage or from the highway bridge several miles below. When the latter place was used it was necessary to measure and subtract the flow of North Branch.

The water is used by the mill of the Sweat-Comings Manufacturing Co., the wheels operating under a head of about 15 feet. The gate openings are controlled hydraulically and cause great fluctuation in the gage heights in low-water periods.

The winter flow of the river is affected by anchor and shore ice, the channel being considerably narrowed.

Conditions for obtaining accurate discharge data are not good and the discharge curve is not accurately defined. This station was discontinued December 4, 1910.

Gage readings were furnished through the courtesy of the Sweat-Comings Manufacturing Co.

Accurate computation of the diurnal fluctuation of discharge caused by the operation of the mills above the station has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since no gage heights recorded at this station are true indices of the daily discharge.

Discharge measurements of Missisquoi River at Richford, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 3[a]	D. M. Wood	183	826	5.75	244
Mar. 24[b]	T. W. Norcross	141	950	8.24	2,300
July 12	G. M. Brett	86	147	5.25	137
Aug. 19[c]	....do	85	93	5.27	165

[a] Measurement made under partial ice cover.
[b] Measurement made at highway bridge, 3 miles below gage.
[c] Measurement made by wading.

ST. FRANCIS RIVER BASIN.

GENERAL FEATURES.

St. Francis River rises in Lake St. Francis, in the district of Beauce, in the southeastern part of the Province of Quebec. After flowing southwest for about 100 miles, it turns to the northwest at almost right angles in the district of Sherbrooke and joins St. Lawrence River in Lake St. Peter. Lake Memphremagog, which crosses the international boundary into Vermont, is tributary to St. Francis River near the bend through Magog River. The principal tributaries of Lake Memphremagog in Vermont are Clyde, Barton, and Black rivers.

Clyde River rises in a lake region near Island Pond, in the northeastern part of Vermont, and flows in a general northwesterly direction to Newport, where it enters Lake Memphremagog. Its basin is considerably broken with hills and low mountains.

Although its drainage area is smaller than that of some other Vermont rivers, it has great opportunities for development. The area contains many natural ponds, and it is possible to create several artificial ponds, which should make the flow of this river very uniform. The stream is very quick spilling. Many power plants are already in place.

No reliable information concerning the mean annual precipitation in this basin is available, but from the data at hand it seems that the average is about 38 inches. Winter conditions are similar to those in the Missisquoi basin.

CLYDE RIVER AT WEST DERBY, VT.

This station, which is located just below the Newport Electric Light Co.'s plant at West Derby, Vt., was established May 25, 1909, in cooperation with the State of Vermont.

At this place are two dams, both operated by the same management. At the upper dam part of the water is used by a paper mill, and the remainder of it is delivered to the water wheels at the electric plant through a steel penstock. The total operating head from this source is about 108 feet. All of the flow from the second dam is diverted to the wheels in the power house, giving a head of about 30 feet. There is practically no water storage at the upper dam, but a pond of considerable size may be made by building a dam above this point.

Near and below the station the river has rapid fall and the bed is very rough.

The low-water section of the staff gage is located about 75 feet below the plant; this was carried away by logs April 10 and replaced

April 18, 1910; the high-water section is nailed to a tree on the right bank, 10 feet farther downstream. July 12, 1910, a chain gage was installed at the same datum to replace the staff gages; all subsequent readings have been made from this gage. The gage datum has remained unchanged throughout the year. Gage heights are furnished by the Newport Electric Light Co.

Discharge measurements are made from a highway bridge about half a mile below the gage.

A good rating curve has not yet been developed. The daily gage heights are subject to much variation as a result of controlled flow.

Accurate computation of the diurnal fluctuation of discharge caused by the operation of the mills above the station has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since no gage heights recorded at this station are true indices of the daily discharge.

Discharge measurements of Clyde River at West Derby, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 25	T. W. Norcross	53	232	[a] 2.95	479
Apr. 18	do	55	237	[c] 2.82	495
20	do	53	231	[a] 2.78	459
July 12	G. M. Brett	50	184	[a] 2.01	114
Aug. 18	do	47	148	[b] 1.86	45.3

[a] Staff gage. [b] Chain gage. [c] Gage height fluctuated considerably during the measurement.

MISCELLANEOUS DISCHARGE MEASUREMENTS IN ST. LAWRENCE RIVER DRAINAGE BASIN.

The following miscellaneous discharge measurements were made in St. Lawrence River drainage basin during 1904, 1905, 1906, and 1910:

Miscellaneous measurements in St. Lawrence River basin in 1904, 1905, 1906, and 1910.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
1904.					
Apr. 12	Canaseraga Creek	Genesee River	At highway bridge at Shakers' Crossing, ½ mile above the mouth of Canaseraga Creek.	7.58	1,050
July 16	do	do	do	3.8	242
1905.					
Mar. 24[a]	do	do	do	18.88	2,010
30	do	do	do	12.32	2,880
31	do	do	do	9.88	2,120
Apr. 1	do	do	do	7.88	1,440
Aug. 25	do	do	do	3.72	252
1906.					
Mar. 29	do	do	do	9.22	1,880
30	do	do	do	8.90	1,620
31[a]	do	do	do	13.55	1,670
Apr. 2	do	do	do	7.85	1,430
3	do	do	do	7.00	1,150
21	do	do	do	4.45	478
1910.					
Apr. 20	do	do	do	6.29	594
July 20	do	do	do	3.90	270
Aug. 21	do	do	do	2.53	37.4
Aug. 22[b]	do	do	do	2.53	36.6
Oct. 26	do	do	do	3.84	260

[a] Measurement affected by backwater from Genesee River.
[b] Made by wading below the bridge.
NOTE.—The gage datum is 25 feet below a reference point on horizontal tiebar 20 feet from left-hand end of downstream side of bridge.
The above measurements of Canaseraga Creek are affected by backwater from Genesee River during high stages of the latter.

Miscellaneous measurements in St. Lawrence River drainage basin in 1910.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Sept. 20	Peshtigo River	Lake Michigan	Near Crivitz, Wis.	1.85	488
Sept. 23[a]	Black River	Lake Ontario	1,000 feet above first highway bridge below Hawkinsville; 2 miles northwest of Boonville.	2.16	80.7
July 22	Raquette River	St. Lawrence River	Near Hosley Camp No. 2, about 1 mile below Forked Lake Outlet.	[b]1,741.6	60.4
25	St. Regis River	St. Lawrence River	At first bridge above Helena, N. Y.	[c]19.36	176
Oct. 29[d]	East Branch of Ausable River.	Ausable River, thence to Lake Champlain.	At highway bridge at Ausable Forks; about ½ mile above confluence with West Branch of Ausable River.	[e]17.75	289
Aug. 13	Winooski River	Lake Champlain	500 feet below farm bridge on L. D. Nute's farm above Marshfield, Vt.	[f]3.15	9.4

[a] This measurement does not include the diversion through Forestport feeder to Black River Canal.
[b] Forked Lake gage.
[c] Distance to water surface from outside upstream tiebar opposite, 166 feet.
[d] Drainage area, 196 square miles.
[e] Reference point to water surface.
[f] All gage heights are distances from reference points to water surface except as noted.

Miscellaneous measurements in St. Lawrence River drainage basin in 1910—Continued.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Aug. 13	Winooski River	Lake Champlain	400 feet above iron bridge about 1 mile below Marshfield, Vt.	10.3	30.0
6	Molly's Brook	Winooski River	Highway bridge on road 1 mile below pond between Marshfield and Danville, Vt.	.....	1.3
5	Peacham's Pond Outlet.	....do	At Bruce's Mill, Peacham, Vt.	.....	4.0
13	....do	....do	50 feet above second highway bridge above dam of Molly Falls Power Co., Marshfield, Vt.	6.5	11.5
Sept. 2	Cranberry Meadow Pond Outlet.	....do	50 feet below first stone culvert under highway above Nelson Pond, near Marshfield, Vt.	2.70	.74
2	Kingsbury Branch	....do	At farm bridge 200 feet below junction with No. 10 Pond Brook, 2¼ miles above North Montpelier, Vt.	7.2	19.8
Aug. 12	....do	....do	At old bridge 500 feet below junction with No. 10 Pond Brook above Montpelier, Vt.	6.5	46.5
Sept. 2	Curtis Pond Outlet	Kingsbury Branch	Calais Center, Vt.	.....	.26
Aug. 11	Stevens Branch	Winooski River	25 feet above highway bridge below Central Vermont Ry. station, Williamstown, Vt.	3.10	3.17
23	....do	....do	20 feet below highway bridge below Central Vermont Ry. station, Williamstown, Vt.	3.40	1.18
11	....do	....do	At bridge, South Barre, Vt.	8.25	11.4
12	Jail Branch	Stevens Branch	¾ mile from East Barre, Vt., on road to Orange, Vt.	[a] 2.0	22.7
23	....do	....do	....do	1.34	4.97
11	....do	....do	200 feet above railroad bridge, Barre, Vt.	[b] 1.75	33.0
23	....do	....do	At railroad bridge, Barre, Vt.	24.58	23.2
13	Worcester Branch	Winooski River	Just above old mill site above Worcester, Vt.	[c] 1.6	13.6
31	....do	....do	....do	[c] 1.27	3.96
12	No. 10 Pond Outlet	Worcester Branch	Just above highway bridge 2½ miles above Montpelier, Vt.	8.4	23.0
Sept. 2	....do	....do	....do	8.9	8.44
Aug. 9	Dog River	Winooski River	400 feet above Corks highway bridge near Northfield, Vt.	.....	3.64
9	East Roxbury Branch of Dog River.	Dog River	50 feet above mouth near Northfield, Vt.	.....	2.50
24	Union Brook	....do	Northfield, Vt.	.....	.09
9	Bull Run Brook	....do	Under highway bridge, Northfield, Vt.	1.85	2.43
30	Mad River	Winooski River	Warren, Vt.	.....	1.74
28	....do	....do	Waitsfield, Vt.	.....	7.72
28	Mill Stream Branch of Mad River.	Mad River	Just above second mill, near Waitsfield, Vt.	.....	2.47
20	Little River	Winooski River	100 feet below junction of East and West Branches, Stowe, Vt.	23.9	36.9
30	....do	....do	....do	24.15	17.1
20	West Branch of Little River.	Little River	200 feet above junction of East and West Branches, Stowe, Vt.	23.9	23.6
30	....do	....do	100 feet above junction of East and West Branches, Stowe, Vt.	24.15	12.3
30	East Branch of Little River.	....do	Just below tailrace of mill at Moss Glen Falls, Stowe, Vt.	10.0	.40

[a] Stake driven beside large rocks, with notch assumed at 2 feet.
[b] Gage at Marvin farm, 1.75.
[c] Stake driven on right bank.

NOTE.—Worcester Branch is named North Branch on 1909 post-route map.
Little River is named Waterbury River on 1909 post-route map.

SUMMARY OF DISCHARGE PER SQUARE MILE.

The following summary of discharge per square mile is given to allow ready comparison of relative rates of run-off from different areas in the St. Lawrence River drainage basin. It shows in a general way the seasonal distribution of run-off and the effect of snow, ground, surface, and artificial storage. But the most important fact worth noting is the almost entire lack of uniformity of agreement between any two stations. It indicates that the discharge of each stream is a law unto itself, and that all projects dependent upon stream flow, if they are to be developed along the safest and most economical lines, must be based on records of stream flow collected with great care over a long series of years as near the location of the project under consideration as possible:

Summary of discharge, in second-feet per square mile, for river stations in the St. Lawrence River drainage basin in 1910.

Gaging station.	Drainage area (square miles).	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
St. Louis River near Thomson, Minn.	3,420	0.25	0.20	0.46	0.85	0.56	0.29	0.16	0.32	0.27	0.40	0.15	0.08	0.33
Whiteface River at Meadowlands, Minn.	442	....	....	....	.89	.98	.60	.25	.29	.31	.70	....	....	....
Cloquet River at Independence, Minn.	698	.32	.43	.53	2.03	.97	.62	.42	.74	.82	.56	.14	.12	.64
Escanaba River near Escanaba, Mich.	800	.38	.31	1.24	2.69	1.61	.68	.28	.46	.48	.67	.69	.34	.82
Menominee River near Iron Mountain, Mich.	2,420	.41	.33	.93	1.53	1.25	.76	.50	.58	.48	.59	.45	.35	.68
Manistee River near Sherman, Mich.	900	1.10	1.00	1.48	1.33	1.14	1.05	.98	.99	1.06	1.04	1.23	1.09	1.12
Huron River at Geddes, Mich.	757	.62	.66	1.10	.64	1.01	.51	.16	.14	.20	.21	.23	.24	.48
Huron River at Flat Rock, Mich.	1,000	.72	.74	1.58	.69	1.08	.51	.18	.17	.20	.22	.24	.29	.55
Genesee River at St. Helena, N. Y.	1,030	1.11	.85	5.32	3.01	1.81	.40	.18	.13	.25	.23	.89	.76	1.24
Genesee River at Jones Bridge, near Mount Morris, N. Y.	1,410	.99	.71	4.96	2.49	1.86	.38	.16	.13	.22	.21	.70	.64	1.12
Genesee River near Rochester, N. Y.	2,360	.81	.53	4.49	1.96	1.75	.38	.16	.12	.23	.23	.55	.47	.98
Canadice Lake Outlet near Hemlock, N. Y.	126	.29	.33	1.82	.87	1.92	.45	.36	.34	.40	.38	.47	.46	.68
Oneida River at Caughdenoy, N. Y.	1,377	2.56	3.45	6.52	2.46	1.21	1.10	.38	.28	.27	.22	.84	.96	1.69
Salmon River near Pulaski, N. Y.	259	....	....	....	....	....	....	....	1.30	1.23	1.63	2.78	1.29	....
Black River near Felts Mills, N. Y.	1,851	1.31	1.04	4.86	3.27	2.14	1.51	.45	.99	.81	1.09	1.38	.69	1.63
Moose River at Moose River, N. Y.	346	1.73	1.45	8.76	5.61	3.35	2.35	.75	1.96	1.18	1.97	1.79	.89	2.65
Oswegatchie River near Ogdensburg, N. Y.	1,580	1.24	1.06	4.92	2.05	1.44	.98	.37	.37	.58	.85	2.03	1.16	1.42
Raquette River at Raquette Falls, near Coreys, N. Y.	418	.60	.72	3.59	6.10	4.74	2.75	.54	.52	.72	.73	.93	.48	1.87
Raquette River at Piercefield, N. Y.	723	.70	.97	2.53	5.91	4.30	2.82	.81	.37	.61	.62	.88	.57	1.76
Raquette River at Massena Springs, N. Y	1,170	.59	.82	3.45	3.90	2.74	2.04	.66	.46	.57	.79	1.03	.56	1.47
Bog River near Tupper Lake, N. Y.	132	.76	.76	3.79	4.91	5.53	2.36	.36	.22	.47	.63	1.06	.61	1.79
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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPER 285

SURFACE WATER SUPPLY OF THE UNITED STATES

1910

PART V. HUDSON BAY AND UPPER MISSISSIPPI RIVER

PREPARED UNDER THE DIRECTION OF M. O. LEIGHTON

BY

ROBERT FOLLANSBEE, A. H. HORTON
AND G. C. STEVENS

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SURFACE WATER SUPPLY OF HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS, 1910.

By Robert Follansbee, A. H. Horton, and G. C. Stevens.

INTRODUCTION.

AUTHORITY FOR INVESTIGATIONS.

This volume contains results of measurements of the flow of certain streams in the United States. The work was performed by the United States Geological Survey, either independently or in cooperation with private or State organizations. The organic law of the Geological Survey (Stat. L., vol. 20, p. 394) contains the following paragraph:

Provided, That this officer [the Director] shall have the direction of the geological survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

As water is the most abundant and most valuable of the minerals the investigation of water resources is authorized under the provision for examining mineral resources. The work has been supported since the fiscal year ending June 30, 1895, by appropriations in successive sundry civil bills passed by Congress under the following item:

For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

The various appropriations that have been made for this purpose are as follows:

Annual appropriations for the fiscal year ending June 30—

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000
1911	150,000

SCOPE OF INVESTIGATIONS.

These investigations are not complete nor are they inclusive of all the streams that might purposefully be studied. The scope of the work is limited by the appropriations available. The field covered is the widest and the character of the work is believed to be the best possible under the controlling conditions. The work would undoubtedly have greater scientific importance and ultimately be of more practical value if the money now expended for wide areas were concentrated on a few small drainage basins; but such a course is impossible because general appropriations made by Congress are applicable to all parts of the country. Each part demands its proportionate share of the benefits.

It is essential that records of stream flow shall be kept during a period of years long enough to determine within reasonable limits the entire range of flow from the absolute maximum to the absolute minimum. The length of such a period manifestly differs for different streams. Experience has shown that the records for some streams should cover 5 to 10 years, and those for other streams 20 years or even more, the limit being determined by the relative importance of the stream and the interdependence of the results with other long-time records on adjacent streams.

In the performance of this work an effort is made to reach the highest degree of precision possible with a rational expenditure of time and a judicious expenditure of a small amount of money. In all engineering work there is a point beyond which refinement is needless and wasteful, and this statement applies with especial force to stream-flow measurements. It is confidently believed that the stream-flow data presented in the publications of the Survey are in general sufficiently accurate for all practical purposes. Many of the records are, however, of insufficient length, owing to the unforeseen reduction of appropriations and consequent abandonment of stations. All persons are cautioned to exercise the greatest care in using such incomplete records.

Records have been obtained at nearly 2,000 different points in the United States. The surface water supply of small areas in Seward Peninsula and the Yukon-Tanana region, Alaska, and in Hawaii has also been investigated. During 1910 regular gaging stations were maintained by the Survey and cooperating organizations at about 1,100 points in the United States, and many discharge measurements were made at other points. Data were also obtained in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country, and will be made available in the regular surface water-supply papers and in special papers from time to time.

PUBLICATIONS.

The data on stream flow collected by the United States Geological Survey have appeared in the annual reports, bulletins, and water-supply papers. Owing to natural processes of evolution and to changes in governmental requirements the character of the work and the territory covered by these different publications have varied greatly. For the purpose of uniformity in the presentation of reports a general plan has been agreed upon by the United States Reclamation Service, the United States Forest Service, the United States Weather Bureau, and the United States Geological Survey, according to which the area of the United States has been divided into twelve parts, whose boundaries coincide with certain natural drainage lines. The areas so described are indicated by the following list of papers on surface water supply for 1910. The dividing line between the north Atlantic and south Atlantic drainage areas lies between York and James rivers.

Papers on surface water supply of the United States, 1910.

Part.	No.	Title.
I	281	North Atlantic coast.
II	282	South Atlantic coast and eastern Gulf of Mexico.
III	283	Ohio River basin.
IV	284	St. Lawrence River basin.
V	285	Upper Mississippi River and Hudson Bay basins.
VI	286	Missouri River basin.
VII	287	Lower Mississippi River basin.
VIII	288	Western Gulf of Mexico.
IX	289	Colorado River basin.
X	290	Great basin.
XI	291	California, Pacific coast.
XII	292	North Pacific coast.

The following table gives the character of data regarding stream flow at regular stations to be found in the various publications of the United States Geological Survey, exclusive of special papers:

Stream-flow data in reports of the United States Geological Survey.

[A=Annual Report; B=Bulletin; WS=Water-Supply Paper.]

Report.	Character of data.	Year.
10th A, pt. 2	Descriptive information only	
11th A, pt. 2	Monthly discharge	1884 to Sept., 1890.
12th A, pt. 2	do	1884 to June 30, 1891.
13th A, pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th A, pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th A, pt. 2	Descriptive information only	
B 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
WS 11	Gage heights (also gage heights for earlier years)	1896.
18th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for earlier years).	1895 and 1896.
WS 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.

Stream-flow data in reports of the United States Geological Survey—Continued.

Report.	Character of data.	Year.
WS 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
WS 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
WS 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th A, pt. 4	Monthly discharge (also for many earlier years)	1898.
WS 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st A, pt. 4	Monthly discharge	1899.
WS 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d A, pt. 4	Monthly discharge	1900.
WS 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
WS 75	Monthly discharge	1901.
WS 82 to 85	Complete data	1902.
WS 97 to 100	do	1903.
WS 124 to 135	do	1904.
WS 165 to 178	do	1905.
WS 201 to 214	Complete data, except descriptions	1906.
WS 241 to 252	Complete data	1907–8.
WS 261 to 272	do	1909.
WS 281 to 292	do	1910.

NOTE.—No data regarding stream flow are given in the fifteenth and seventeenth annual reports.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing records prior to 1904 has been published in Water-Supply Paper 119.

The first table which follows gives, by years and drainage basins, the numbers of the papers on surface water supply published from 1899 to 1910. Wherever the data for a drainage basin appear in two papers the number of one is placed in parentheses and the portion of the basin covered by that paper is indicated in the second table. For example, in 1904 the data for Missouri River were published in Water-Supply Papers 130 and 131, and the portion of the records contained in Water-Supply Paper 131, as indicated by the second table, is that relating to Platte and Kansas rivers.

Numbers of water-supply papers containing results of stream measurements, 1899–1910.

	1899 [1]	1900 [2]	1901	1902	1903
Atlantic coast and eastern Gulf of Mexico:					
New England rivers	35	47	65,75	82	97
Hudson River to Delaware River, inclusive	35	47,(48)	65,75	82	97
Susquehanna River to York River, inclusive	35	48	65,75	82	97
James River to Yadkin River, inclusive	(35),36	48	65,75	(82),83	(97),98
Santee River to Pearl River, inclusive	36	48	65,75	83	98
St. Lawrence River	36	49	65,75	(82),83	97
Hudson Bay			66,75	85	100
Mississippi River:					
Ohio River	36	48,(49)	65,75	83	98
Upper Mississippi River	36	49	65,75	83	98,(99)
Missouri River	(36),37	49,(50)	66,75	84	99
Lower Mississippi River	37	50	{(65), 66,75}	(83),84	(98),99
Western Gulf of Mexico	37	50	66,75	84	99
Pacific coast and Great Basin:					
Colorado River	(37),38	50	66,75	85	100
Great Basin	38,(39)	51	66,75	85	100
South Pacific coast to Klamath River, inclusive	(38),39	51	66,75	85	100
North Pacific coast	38	51	66,75	85	100

[1] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39.
[2] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52.

Numbers of water-supply papers containing results of stream measurements, 1899–1910—Continued.

	1904	1905	1906	1907–8	1909	1910
Atlantic coast and eastern Gulf of Mexico:						
New England rivers	124	165	201	241	261	281
Hudson River to Delaware River, inclusive	125	166	202	241	261	281
Susquehanna River to York River, inclusive	126	167	203	241	261	281
James River to Yadkin River, inclusive	126	167	203	242	262	282
Santee River to Pearl River, inclusive	127	168	204	242	262	282
St. Lawrence River	129	170	206	244	264	284
Hudson Bay	130	171	207	245	265	285
Mississippi River:						
Ohio River	128	169	205	243	263	283
Upper Mississippi River	128, (130)	171	207	245	265	285
Missouri River	130, (131)	172	208	246	266	286
Lower Mississippi River	(128), 131	(169), 173	(205), 209	247	267	287
Western Gulf of Mexico	132	174	210	248	268	288
Pacific coast and Great Basin:						
Colorado River	133, (134)	175, (177)	211, (213)	249, (251)	269, (271)	289
Great Basin	133, (134)	176, (177)	212, (213)	250, (251)	270, (271)	290
South Pacific coast to Klamath River, inclusive	134	177	213	251	271	291
North Pacific coast	135	(177), 178	214	252	272	292

Numbers of water-supply papers containing data covering portions of drainage basins.

No.	River basin.	Tributaries included.
35	James	
36	Missouri	Gallatin.
37	Colorado	Green, Gunnison, Grand above junction with Gunnison.
38	Sacramento	Except Kings and Kern.
39	Great Basin	Mohave.
48	Delaware	Wissahickon and Schuylkill.
49	Ohio	Scioto.
50	Missouri	Loup and Platte near Columbus, Nebr. All tributaries below junction with Platte.
65	Lower Mississippi	Yazoo.
82	James	
	St. Lawrence	Lake Ontario, tributaries to St. Lawrence River proper.
83	Lower Mississippi	Yazoo.
97	James	
98	Lower Mississippi	Do.
99	Upper Mississippi	Tributaries from the west.
128	Lower Mississippi	Yazoo.
130	Upper Mississippi	Tributaries from the west.
131	Missouri	Platte, Kans.
134	Colorado	Data near Yuma, Ariz., repeated.
	Great Basin	Susan, Owens, Mohave.
169	Lower Mississippi	Yazoo.
177	Colorado	Below junction with Gila.
	Great Basin	Susan repeated, Owens, Mohave.
	North Pacific coast	Rogue, Umpqua, Siletz.
205	Lower Mississippi	Yazoo, Homochitto.
213	Colorado	Data at Hardyville repeated; at Yuma, Salton Sea.
	Great Basin	Owens, Mohave.
251	Colorado	Yuma and Salton Sea stations repeated.
271	Great Basin	Owens River basin.

The order of treatment of stations in any basin in these papers is downstream. The main stem of any river is determined by measuring or estimating the drainage area; that is, the headwater stream having the largest drainage area is considered the continuation of the main stream, and local changes in name and lake surface are disregarded. Records for all stations from the source to the mouth of the

main stem of the river are presented first, and records for the tributaries in regular order from source to mouth follow, all records in each tributary basin being given before those of the next basin below.

The exceptions to this rule occur in the records for Mississippi River, which are given in four parts, as indicated above, and in the records for large lakes, where it is simpler to take up the streams in regular order around the rim of the lake than to cross back and forth over the lake surface.

DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and run-off in second-feet per square mile, and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. The units used in this series of reports are second-feet, second-feet per square mile, and run-off in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed by the use of the factors given in the following table of equivalents.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work.

CONVENIENT EQUIVALENTS.

The following is a list of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).

1 second-foot equals 38.4 Colorado miner's inches.

1 second-foot equals 40 Arizona miner's inches.

1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.

1 second-foot equals 6.23 British imperial gallons per second.

1 second-foot for one year covers 1 square mile 1.131 feet or 13.572 inches deep.
1 second-foot for one year equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot for one day covers 1 square mile 0.03719 inch deep.
1 second-foot for one 28-day month covers 1 square mile 1.041 inches deep.
1 second-foot for one 29-day month covers 1 square mile 1.079 inches deep.
1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.
1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep.
1 second-foot for one day equals 1.983 acre-feet.
1 second-foot for one 28-day month equals 55.54 acre-feet.
1 second-foot for one 29-day month equals 57.52 acre-feet.
1 second-foot for one 30-day month equals 59.50 acre-feet.
1 second-foot for one 31-day month equals 61.49 acre-feet.
100 California miner's inches equals 18.7 United States gallons per second.
100 California miner's inches equals 96.0 Colorado miner's inches.
100 California miner's inches for one day equals 4.96 acre-feet.
100 Colorado miner's inches equals 2.60 second-feet.
100 Colorado miner's inches equals 19.5 United States gallons per second.
100 Colorado miner's inches equals 104 California miner's inches.
100 Colorado miner's inches for one day equals 5.17 acre-feet.
100 United States gallons per minute equals 0.223 second-foot.
100 United States gallons per minute for one day equals 0.442 acre-foot.
1,000,000 United States gallons per day equals 1.55 second-feet.
1,000,000 United States gallons equals 3.07 acre-feet.
1,000,000 cubic feet equals 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-feet.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.
1⅓ horsepower equals about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel realizing 80 per cent of theoretical power

EXPLANATION OF DATA.

For each drainage basin there is given a brief general description covering such items as area, source, tributaries, topography, geology, forestation, rainfall, irrigation, storage, power, and other interesting or important facts.

For each regular current-meter gaging station the following data, so far as available, are given: Description of station, list of discharge measurements, table of daily gage heights, table of daily discharges, table of monthly and yearly discharges, and run-off. For stations located at weirs or dams the gage height table is omitted.

In addition to statements regarding the location and installation of current-meter stations, the descriptions give information in regard to any conditions which may affect the constancy of the relation of gage height to discharge, covering such points as ice, logging, shifting channels, and backwater; also information regarding diversions which decrease the total flow at the measuring section. Statements are also made regarding the accuracy and reliability of the data.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, name of hydrographer, width and area of cross section, gage height, and discharge in second-feet.

The table of daily gage heights records the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. At most stations the gage is read in the morning and in the evening. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. All gage heights affected by the presence of ice in the streams or by backwater from obstructions are published as recorded, with suitable footnotes. The rating table is not applicable for such periods unless the proper corrections to the gage heights are known and applied. Attention is called to the fact that the zero of the gage is placed at an arbitrary datum and has no relation to zero flow or the bottom of the river. In general the zero is located somewhat below the lowest known flow, so that negative readings shall not occur.

The discharge measurements and gage heights are the base data from which rating tables, daily discharge tables, and monthly discharge tables are computed.

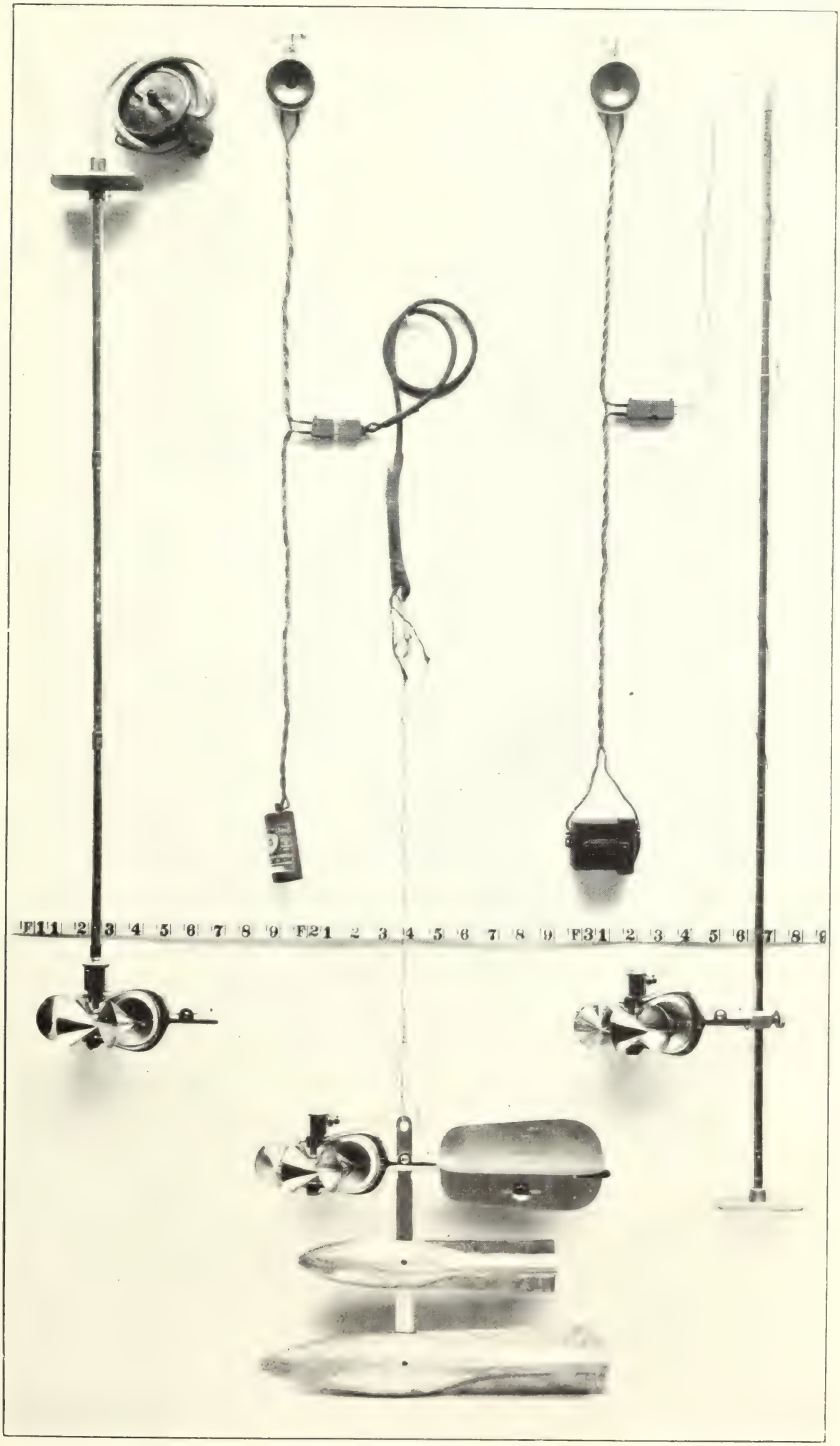
The rating table gives, either directly or by interpolation, the discharge in second-feet corresponding to every stage of the river recorded during the period for which it is applicable. It is not published in this report, but can be determined from the daily gage heights and daily discharges for the purpose of verifying the published results as follows:

First plot the discharge measurements for the current and earlier years on cross-section paper, with gage heights in feet as ordinates and discharge in second-feet as abscissas. Then tabulate a number of gage heights taken from the daily gage-height table for the complete range of stage given and the corresponding discharges for the days selected from the daily discharge table and plot the values

A. FOR BRIDGE MEASUREMENT.

B. FOR WADING MEASUREMENT.

TYPICAL GAGING STATIONS.



SMALL PRICE CURRENT METERS.

on cross-section paper. The last points plotted will define the rating curve used and will lie among the plotted discharge measurements. After drawing the rating curve, a table can be developed by scaling off the discharge in second-feet for each tenth foot of gage height. These values should be so adjusted that the first differences shall always be increasing or constant, except for known backwater periods.

The table of daily discharges gives the discharges in second-feet corresponding to the observed gage heights as determined from the rating tables.

In the table of monthly discharge the column headed "Maximum" gives the mean flow, as determined from the rating table, for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the stage when the water surface was at crest height and the corresponding discharge was consequently larger than given in the maximum column. Likewise, in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this the computations for the remaining columns, which are defined on page 12, are based.

The field methods used in the collection of the data presented in this series of reports are described in the introductory sections of Water-Supply Papers 261 to 272, inclusive, "Surface water supply of the United States, 1909." Plate I shows typical gaging stations, indicating the method of suspending the current meter; Plate II shows the types of current meters [1] used in the work.

ACCURACY AND RELIABILITY OF FIELD DATA AND COMPARATIVE RESULTS.

The accuracy of stream-flow data depends primarily on the natural conditions at the gaging station and on the methods and care with which the data are collected. Errors of the first group depend on the degree of permanency of channel and of permanency of the relation between discharge and stage.

Errors of the second class are due, first, to errors in observation of stage; second, to errors in measurements of flow; and, third, to errors due to misinterpretation of stage and flow data.

Practically all discharge measurements made under fair conditions are well within 5 per cent of the true discharge at the time of observation. Inasmuch as the errors of meter measurements are largely

[1] See Hoyt, J. C., and others, Use and care of current meter as practiced by the U. S. Geol. Survey; Trans. Am. Soc. Civil Eng., vol. 66, 1910, p. 70.

compensating, the mean rating curve, when well defined, is much more accurate than the individual measurements. Numerous experiments made to test the accuracy of current-meter work show that it compares very favorably with the results from standard weirs and, owing to simplicity of methods, usually gives results that are much more reliable than those from stations at dams, where the coefficient may be uncertain and conditions of flow are complicated.

The work is, of course, dependent on the reliability of the gage observers. With relatively few exceptions the observers perform their work honestly. The records are, however, closely watched, and the cause of any discrepancy is investigated. It is obvious that one gage reading a day does not always give the mean height for that day. As an almost invariable rule, however, errors from this source are compensating and virtually negligible in a period of one month, although a single day's reading may, when taken by itself, be considerably in error.

An effort is made to visit every station at least once each year for the purpose of making a measurement to determine the constancy of conditions of flow since the last measurement made in the preceding year, and also to check the elevation of the gage. On account of lack of funds or for other causes some stations were not visited during the current year. If conditions of flow have been reasonably permanent up to the time of the last preceding measurements, it is considered best to publish estimates of discharge based on the latest verified rating curve rather than to omit then altogether, although it should be distinctly understood that such records are at times subject to considerable error. This is also true, although to a less degree, of the period of records since the date of the last measurement of the current year. As a rule, the accuracy notes are based on the assumption that the rating curve used is strictly applicable to the current year.

In order to give engineers and others information regarding the probable accuracy of the computed results, footnotes are added to the daily discharge tables, stating the probable accuracy of the rating tables used, and an accuracy column is inserted in the monthly discharge table. For the rating tables "well defined" indicates, in general, that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined" or "approximate," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The accuracy column in the monthly discharge table does not apply to the maximum or minimum nor to any individual day, but to the monthly mean. It is based on the accuracy of the rating, the probable reliability of the observer, and knowledge of local conditions. In this column A indicates that the mean monthly flow is probably

accurate within 5 per cent; B, within 10 per cent; C, within 15 per cent; D, within 25 per cent. Special conditions are covered by footnotes.

In general, the base data which are collected in the field each year by the Survey engineers are published, not only to comply with the law but also for the express purpose of giving to any engineer the opportunity of examining the computed results and of changing and adjusting them as may seem best to him. Although it is believed that the rating tables and computed monthly discharges are as good as the base data up to and including the current year will warrant, it should always be borne in mind that the additional data collected at each station from year to year nearly always throw new light on data already collected and published, and hence allow more or less improvement in the computed results of earlier years. It is therefore expected that the engineer who makes serious use of the figures presented in these papers will verify all ratings and make such adjustments for earlier years as may seem necessary. The work of compiling, studying, revising, and republishing data for different drainage basins for 5 or 10 year periods or more is carried on by the United States Geological Survey so far as the funds for such work are available.

The estimates in the table of monthly discharge are so arranged as to give only a general idea of the conditions of flow at the station, and it is not expected that they will be used for other than preliminary estimates.

The daily discharges are published to allow a more detailed study of the variation in flow and to determine the periods of deficient flow.

COOPERATIVE DATA.

Cooperative data of various kinds and data regarding the run-off at many stations maintained wholly by private funds are incorporated in the surface water-supply reports of the United States Geological Survey.

Many stations throughout the country are maintained for specific purposes by private parties who supply the records gratuitously to the United States Geological Survey for publication. When such records are furnished by responsible parties and appear to be reasonably accurate, they are verified, so far as possible, and estimated values of accuracy are given. Records clearly worthless or misleading are not published. As it is, however, impossible to completely verify all such records furnished—because of lack of funds or for other causes—they are published for what they are worth, as they are of value as a matter of record and afford at least approximate information regarding stream flow at the particular localities. The

Survey does not, however, assume any responsibility for inaccuracies found in such records, although most of them are believed to be reasonably good.

COOPERATION AND ACKNOWLEDGMENTS.

Assistance has been rendered or records furnished by the following, to whom special acknowledgment is due: United States Engineer Corps, for unpublished records of flow from the reservoirs on the upper Mississippi and miscellaneous low-water measurements; United States Reclamation Service, for maintenance of stations in the St. Mary basin; United States Weather Bureau, for records of gage heights at St. Paul, Mankato, and Chippewa Falls; Minnesota & Ontario Power Co., for cooperation in the maintenance of the station at International Falls; St. Anthony Falls Water Power Co., for records of Mississippi at Minneapolis; Kettle River Co., for cooperation in maintenance of the Sandstone station; Consumers Power Co., for cooperation in maintenance of the station at Rapidan Mills; Wisconsin Valley Improvement Co., for gage-height records at Rhinelander, Merrill, and Necedah; Chippewa Valley Railway, Light & Power Co., for gage records at Cedar Falls; Mr. Frank Dearborn, for gage records at Stone City.

The work in Minnesota during 1910 has been done with State cooperation under the terms of an act of the legislature of 1909, as embodied in joint resolution 19, which reads as follows:

Whereas the water supplies, water powers, navigation of our rivers, drainage of our lands, and the sanitary condition of our streams and their watersheds generally form one great asset and present one great problem: Therefore be it resolved by the house of representatives, the senate concurring, That the State drainage commission be and is hereby directed to investigate progress in other States toward the solution of said problem in such States, to investigate and determine the nature of said problem in this State. * * *

The work has been carried on in conjunction with the State drainage commission, George A. Ralph, chief engineer.

The work in Illinois during 1910 has been done with the cooperation of the internal improvement commission, the organic law of which provides (Session Laws, Forty-fifth General Assembly, adjourned session, p. 33):

The duties of the commission shall be to investigate * * * the reclamation of lands subject to overflow or inundation * * * and such other statistics and data as will enable the next general assembly to properly formulate and devise ways and means whereby legislative enactment may be had to carry out and put into effect the benefits to be derived by the * * * reclamation of lands subject to inundation in Illinois.

Mr. Isham Randolph was chairman of the internal improvement commission.

DIVISION OF WORK.

The field data for the Hudson Bay drainage basin were collected under the direction of Robert Follansbee and W. A. Lamb, district engineers, assisted by E. F. Chandler, G. A. Gray, M. E. McChristie, and J. O. Nomland.

The field data for the upper Mississippi drainage basin were collected under the direction of Robert Follansbee and A. H. Horton, district engineers, assisted by C. R. Adams, G. A. Gray, C. J. Emerson, H. J. Jackson, C. T. Bailey, and P. S. Monk.

The ratings, special estimates, and studies of the completed data were made by Robert Follansbee, A. H. Horton, W. A. Lamb, G. C. Stevens, and E. F. Chandler.

The computations and preparation of the completed data for publication were made under the direction of G. C. Stevens, by G. A. Gray, Raymond Richards, R. C. Rice, M. I. Walters, J. G. Mathers, G. H. Canfield, J. J. Phelan, and B. E. Jones. The report was edited by Mrs. B. D. Wood.

GAGING STATIONS MAINTAINED IN THE HUDSON BAY AND UPPER MISSISSIPPI RIVER DRAINAGE BASINS.

The following list comprises the gaging stations maintained in the Hudson Bay and upper Mississippi River basins by the United States Geological Survey and cooperative parties. Data for these stations have been published in the reports listed on pages 9 to 11. The stations are arranged by river basins, in downstream order, tributaries of main streams being indicated by indention. (See p. 11).

HUDSON BAY BASIN.

St. Mary River above Swiftcurrent Creek near Babb (formerly Main), Mont., 1902–1910.
St. Mary River below Swiftcurrent Creek at Babb (formerly Main), Mont., 1901–2, 1910.
St. Mary River near Cardston, Alberta, 1902–1910.
  Swiftcurrent Creek near Babb, Mont., 1902–1910.
  Kennedy Creek near Babb, Mont., 1903–1906.
Ottertail River (head of Red River), near Fergus Falls, Minn., 1904–1910.
Red River near Fergus Falls, Minn., 1909–10.
Red River at Fargo, N. Dak., 1901–1910.
Red River at Grand Forks, N. Dak., 1901–1910 (gage height record 1895–1901).
Red River at Emerson, Manitoba, 1902.
  Pelican River near Fergus Falls, Minn., 1909–10.
  Sheyenne River at Haggart, N. Dak., 1902–1907.
    Devils Lake near Devils Lake, N. Dak., 1901–1910.
  Wild Rice River at Twin Valley, Minn., 1909–10.
  Red Lake River at Thief River Falls, Minn., 1909–10.

Red River—Continued.
Red Lake River at Crookston, Minn., 1901–1910.
Thief River near Thief River Falls, Minn., 1909–10.
Clearwater River at Red Lake Falls, Minn., 1909-10.
Pembina River at Neche, N. Dak., 1903–1910.
Mouse River near Foxholm, N. Dak., 1904–1906.
Mouse River at Minot, N. Dak., 1903–1910.
Des Lacs River at Foxholm, N. Dak., 1904–1906.
Rainy Lake near Rainier, Minn., 1910.
Rainy River at International Falls, Minn., 1909–10.
Little Fork Rainy River at Little Fork, Minn., 1909–10.
Big Fork River at Big Falls, Minn., 1909–10.
Big Fork River near Laurel, Minn., 1909.
Black River near Loman, Minn., 1909.

UPPER MISSISSIPPI RIVER BASIN.

Mississippi River above Sandy River, Minn., 1895–1910.
Mississippi River near Fort Ripley, Minn., 1909–10.
Mississippi River near Sauk Rapids, Minn., 1903–1906.
Mississippi River at Anoka, Minn., 1905–1910.
Mississippi River at St. Paul, Minn., 1873–1901.
Sandy River below Sandy Lake Reservoir, Minn., 1910.
Pine River below Pine River Reservoir, Minn., 1910.
Prairie River near Grand Rapids, Minn., 1909.
Crow Wing River at Nimrod, Minn., 1910.
Crow Wing River at Motley, Minn., 1909.
Crow Wing River at Pillager, Minn., 1903 and 1909–10.
Long Prairie River near Motley, Minn., 1909–10.
Sauk River near St. Cloud, Minn., 1909–10.
Crow River, North Fork, near Rockford, Minn., 1909–10.
Crow River at Rockford, Minn., 1909–10.
Crow River near Dayton, Minn., 1906.
Crow River, South Fork, near Rockford, Minn., 1909–10.
Rum River at Onamia, Minn., 1909–10.
Rum River at Cambridge, Minn., 1909–10.
Rum River at St. Francis, Minn., 1903.
Rum River near Anoka, Minn., 1905–1909.
Minnesota River near Odessa, Minn., 1909–10.
Minnesota River near Montevideo, Minn., 1909–10.
Minnesota River near Mankato, Minn., 1903–1910.
Whetstone River near Big Stone, S. Dak., 1910.
Lac qui Parle River at Lac qui Parle, Minn., 1910.
Chippewa River near Watson, Minn., 1909–10.
Redwood River near Redwood Falls, Minn., 1909–10.
Cottonwood River near New Ulm, Minn., 1909–10.
Blue Earth River at Rapidan Mills, Minn., 1909–10.
St. Croix River:
Kettle River near Sandstone, Minn., 1909–10.
Snake River at Mora, Minn., 1909–10.
Cannon River at Welch, Minn., 1909–10.
Chippewa River at Chippewa Falls, Wis., 1899–1910.
Chippewa River near Eau Claire, Wis., 1902–1910.
Flambeau River near Ladysmith, Wis., 1903–1906.
Red Cedar River at Cedar Falls, Wis., 1907–1910.
Red Cedar River at Menominee, Wis., 1907–8.

Mississippi River—Continued.
Zumbro River at Zumbro Falls, Minn., 1909–10.
Black River at Neillsville, Wis., 1905–1910.
Black River at Melrose, Wis., 1902–3.
Root River near Houston, Minn., 1909–10.
Root River, North Branch, near Lanesboro, Minn., 1910.
Wisconsin River near Rhinelander, Wis., 1905–1910.
Wisconsin River at Merrill, Wis., 1902–1910.
Wisconsin River near Necedah, Wis., 1902–1910.
Wisconsin River at Muscoda, Wis., 1902–3.
Maquoketa River at Manchester, Iowa, 1903.
Wapsipinicon River at Stone City, Iowa, 1903–1910.
Rock River above mouth of Pecatonica River at Rockton, Ill., 1903.
Rock River below mouth of Pecatonica River at Rockton, Ill., 1903–1910.
Rock River near Nelson, Ill., 1906.
Rock River at Sterling, Ill., 1905–6.
Catfish River at Madison, Wis., 1902–3.
Lake Mendota at Madison, Wis., 1902–3.
Iowa River at Marshalltown, Iowa, 1903.
Iowa River at Iowa City, Iowa, 1903–1906.
Cedar River near Austin, Minn., 1909–10.
Red Cedar River at Janesville, Iowa, 1905–6.
Cedar River at Cedar Rapids, Iowa, 1903–1910.
Des Moines River at Jackson, Minn., 1910.
Des Moines River at Fort Dodge, Iowa, 1905–6.
Des Moines River at Des Moines, Iowa, 1902–3, 1905–6.
Des Moines River at Keosauqua, Iowa, 1903–1906.
Raccoon River near Des Moines, Iowa, 1902–3.
Illinois River near Minooka, Ill., 1903–4.
Illinois River near Seneca, Ill., 1903.
Illinois River near Ottawa, Ill., 1903–4.
Illinois River near La Salle, Ill., 1903.
Illinois River near Peoria, Ill., 1903–1906.
Kankakee River at Davis, Ind., 1905–6.
Kankakee River at Momence, Ill., 1905–6.
Yellow River at Knox, Ind., 1905–6.
Desplaines River above mouth of Jackson Creek near Channahon, Ill., 1903–1906.
Desplaines River above Kankakee River near Channahon, Ill, 1902–3.
Fox River at Sheridan, Ill., 1905–6.
Fox River at Ottawa, Ill., 1903.
Sangamon River at Monticello, Ill., 1908 and 1910.
Sangamon River at Decatur, Ill., 1905.
Sangamon River at Riverton, Ill., 1908–1910.
Sangamon River near Springfield, Ill., 1903.
Sangamon River near Oakford, Ill., 1909–10.
Sangamon River near Chandlerville, Ill., 1908.
Sangamon River, South Fork, near Taylorville, Ill., 1908–1910.
Salt Creek near Kenny, Ill., 1908–1910.
Cahokia Creek at Poag, Ill., 1909–10.
Kaskaskia River near Arcola, Ill., 1908–1910.
Kaskaskia River at Shelbyville, Ill., 1908–1910.
Kaskaskia River at Vandalia, Ill., 1908–1910.
Kaskaskia River at Carlysle, Ill., 1908–1910.

Mississippi River—Continued.
Kaskaskia River at New Athens, Ill., 1909–10.
Shoal Creek near Breese, Ill., 1909–10.
Silver Creek near Lebanon, Ill., 1908–1910.
Big Muddy River near Cambon, Ill., 1908–1910.
Beaucoup Creek near Pinckneyville, Ill., 1908–1910.

HUDSON BAY DRAINAGE AREA IN THE UNITED STATES.

PRINCIPAL STREAMS.

All the waters that reach Hudson Bay from the United States pass through Lake Winnipeg and thence into the bay through Nelson River. The principal tributaries of Lake Winnipeg, and thus, indirectly, of Nelson River, are Saskatchewan, Red, and Winnipeg rivers. The Saskatchewan drains the major portions of the Provinces of Alberta and Saskatchewan in the Dominion of Canada, and, through St. Mary River, a small area in northwestern Montana in the United States. Red River drains a large basin in the United States, covering portions of Minnesota and North and South Dakota. Winnipeg River is the outlet of Lake of the Woods, which receives Rainy River, an international stream rising in Rainy Lake.

ST. MARY RIVER.

GENERAL FEATURES OF AREA DRAINED.

St. Mary River heads in northern Montana, near the Canadian boundary line, on the eastern slope of the main range of the Rocky Mountains, in a region of perpetual snow and in the midst of innumerable glaciers. It starts from the great Blackfoot Glacier, probably the largest in the Rocky Mountains within the United States, and receives affluents from at least a dozen lesser glaciers. These small streams unite within a short distance from their sources and flow into a lake which is hemmed in by high mountains and is known as Upper St. Mary Lake. Below this lake and separated from it by a narrow strip of land is Lower St. Mary Lake. The aggregate length of these two lakes is about 22 miles. The river flows out of the lower lake, the elevation of which is 4,460 feet above sea level, and within 2 miles is joined by Swiftcurrent Creek, which is fed by waters of Grinnell Glacier and four small glaciers. From the confluence of these streams to the international boundary, a distance of 12 miles, the St. Mary flows in a northerly direction, receiving Kennedy Creek a few miles before crossing the boundary. Entering the Province of Alberta it empties into Belly River, its waters eventually finding their way through the Saskatchewan into Hudson Bay.[1]

[1] Information and data on stations maintained by the Dominion of Canada in this basin are contained in a Report of Progress of Stream Measurements for 1909, published by the Department of Interior, Dominion of Canada.

That portion of the drainage area below the region of glaciers is heavily forested, the timber consisting of spruce and fir on the higher slopes and a dense growth of willows and aspen on the lower portions.

The mean annual precipitation is about 60 inches, and occurs in greater part in the form of snow. The altitude of the drainage basin within the United States ranges from 4,000 feet to 10,000 feet.

The only diversion from the St. Mary in the United States is that which is being made by the United States Reclamation Service in connection with the Milk River project. It is proposed to reservoir Lower St. Mary Lake and divert 850 second-feet of water into the Milk River drainage basin. Both Upper and Lower St. Mary lakes can be made into storage reservoirs. Water power is not important in this basin, as the many small streams which form the river are frozen over during the winter months.

ST. MARY RIVER NEAR BABB, MONT.

This station, which was established April 9, 1902, for the purpose of procuring run-off data for use in connection with irrigation projects on the Blackfoot Indian Reservation and in the Milk River valley is located below Lower St. Mary Lake, above the mouth of Swiftcurrent Creek, the nearest tributary, and about 2 miles south of Babb. The run-off at this point is that from Upper and Lower St. Mary lakes. The drainage area is 177 square miles. No water is diverted above the station, but the United States Reclamation Service has appropriated 850 second-feet of water which will be diverted near the station. A reservoir will also be formed at Lower St. Mary Lake.

Discharge measurements are made from a cable or by wading. The cable was originally located about 4,500 feet below Lower St. Mary Lake and about 2,500 feet above the mouth of Swiftcurrent Creek. It was moved about 300 feet upstream to a better location on September 13, 1909. The chain gage, which is located about 1,000 feet above the original cable, has been maintained at a constant datum since the station was established.

Discharge measurements of St. Mary River near Babb, Mont., 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 19	W. A. Lamb	103	359	2.22	480
May 12	....do	108	536	3.80	1,580
June 9	M. E. McChristie	109	519	3.62	1,460
23	W. A. Lamb	104	479	3.50	1,250
Aug. 1	M. E. McChristie	103	373	2.28	567
Sept. 16	....do	89	287	1.42	204
Nov. 18	B. E. Jones	103	376	2.20	515
Dec. 30[a]	....do	94	274	1.06	94

[a] Ice at gage. Height is referred to regular gage, and was obtained by use of a temporary gage with a known relation to the regular gage.

Daily gage height in feet of St. Mary River near Babb, Mont., for 1910.

[Chas. E. Hayes, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.70	3.50	3.85	3.25	2.25	1.50	1.80	2.20	1.60
2	.....	1.70	3.40	3.90	3.20	2.20	1.50	2.00	2.20	1.60
3	.....	1.70	3.30	3.95	3.20	2.20	1.50	2.00	2.20	1.50
4	.....	1.60	3.15	3.90	3.20	2.10	1.50	2.00	2.10	1.60
5	.....	1.50	3.00	3.75	3.15	2.10	1.50	2.20	2.10	1.60
6	.....	1.50	3.00	3.60	3.10	2.05	1.50	2.50	2.00	1.60
7	.....	1.50	3.00	3.55	3.00	2.05	1.50	2.30	2.00	1.50
8	.....	1.60	3.15	3.70	2.95	2.00	1.50	2.60	2.00	1.50
9	.....	1.60	3.40	3.60	2.90	2.00	1.50	2.70	2.00	1.50
10	.....	1.80	3.65	3.60	2.85	2.00	1.45	2.70	2.00	1.50
11	.....	1.70	3.80	3.60	2.80	2.00	1.45	2.80	2.00	.....
12	.....	1.80	3.80	3.60	2.75	1.98	1.45	2.90	2.10	1.50
13	1.20	1.85	3.70	3.65	2.75	1.95	1.45	2.90	2.10	1.50
14	1.20	1.90	3.65	3.60	2.70	1.90	1.45	2.80	2.10	1.50
15	1.20	2.00	3.65	3.60	2.70	1.90	1.45	2.70	2.20	1.50
16	1.20	2.05	3.55	3.70	2.70	1.90	1.45	2.60	2.20	1.40
17	1.20	2.10	3.40	3.75	2.70	1.90	1.50	2.50	2.20	1.30
18	1.20	2.10	3.20	3.80	2.70	1.80	1.50	2.40	2.20	1.30
16	1.20	2.15	3.25	3.80	2.65	1.80	1.50	2.30	2.20	1.30
20	1.30	2.30	3.20	3.75	2.65	1.80	1.60	2.30	2.20	1.30
21	1.20	2.35	3.10	3.65	2.85	1.80	1.60	2.20	2.10	1.30
22	1.30	2.45	3.10	3.60	2.60	1.70	1.60	2.10	2.10	1.30
23	1.40	2.55	3.10	3.45	2.60	1.70	1.70	2.00	2.00	1.30
24	1.40	2.65	3.10	3.30	2.60	1.80	1.80	2.00	2.00	1.30
25	1.50	2.70	3.35	3.20	2.55	1.70	1.80	2.00	1.90	.....
26	1.50	2.85	3.55	3.20	2.40	1.70	1.80	2.10	1.90	.....
27	1.60	3.00	3.75	3.20	2.40	1.60	1.80	2.20	1.85	.....
28	1.60	3.25	3.80	3.20	2.40	1.60	1.80	2.10	1.85	.....
29	1.70	3.45	3.80	3.25	2.35	1.60	1.80	2.30	1.80	.....
30	1.80	3.50	3.85	3.25	2.30	1.50	1.80	2.20	1.70	.....
31	1.70	.....	3.90	.....	2.30	1.50	.....	2.20	.....	.....

NOTE.—Ice present Jan. 1 to Mar. 12 and Dec. 25 to 31.

Daily discharge in second-feet of St. Mary River near Babb, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	295	1,290	1,600	1,100	525	230	330	500	260
2	.....	295	1,210	1,660	1,060	500	230	410	500	260
3	.....	295	1,130	1,710	1,060	500	230	410	500	230
4	.....	260	1,030	1,660	1,060	450	230	410	450	260
5	.....	230	935	1,510	1,030	450	230	500	450	260
6	.....	230	935	1,380	995	430	230	650	410	260
7	.....	230	935	1,340	935	430	230	550	410	230
8	.....	260	1,030	1,470	905	410	230	700	410	230
9	.....	260	1,210	1,380	875	410	230	755	410	230
10	.....	330	1,420	1,380	845	410	215	755	410	230
11	.....	295	1,560	1,380	815	410	215	815	410	230
12	.....	330	1,560	1,380	785	402	215	875	450	230
13	143	350	1,470	1,420	785	390	215	875	450	230
14	143	370	1,420	1,380	755	370	215	815	450	230
15	143	410	1,420	1,380	755	370	215	755	500	230
16	143	430	1,340	1,470	755	370	215	700	500	200
17	143	450	1,210	1,510	755	370	230	650	500	170
18	143	450	1,060	1,560	755	330	230	600	500	170
19	143	475	1,100	1,560	728	330	230	550	500	170
20	170	550	1,060	1,510	728	330	260	550	550	170
21	143	575	995	1,420	845	330	260	500	450	170
22	170	625	995	1,380	700	295	260	450	450	170
23	200	675	995	1,250	700	295	295	410	410	170
24	200	728	995	1,130	700	330	330	410	410	170
25	230	755	1,170	1,060	675	295	330	410	370	140
26	230	845	1,340	1,060	600	295	330	450	370	140
27	260	935	1,510	1,060	600	260	330	500	350	140
28	260	1,100	1,560	1,060	600	260	330	450	350	120
29	295	1,250	1,560	1,100	575	260	330	550	330	100
30	330	1,290	1,600	1,100	550	230	330	500	295	100
31	295	.....	1,660	.....	550	230	.....	500	.....	75

NOTE.—Daily discharge computed from a well-defined rating curve. Discharge estimated Dec. 25 to 31 because of presence of ice.

Monthly discharge of St. Mary River near Babb, Mont., for 1910.

[Drainage area, 177 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	90	0.508	0.59	5,530	D.
February	.....	.....	100	.565	.59	5,500	D.
March	330	.....	169	.955	1.10	10,400	D.
April	1,290	230	519	2.93	3.27	30,900	A.
May	1,660	935	1,250	7.06	8.14	76,900	A.
June	1,710	1,060	1,380	7.80	8.70	82,100	A.
July	1,100	550	793	4.48	5.16	48,800	A.
August	525	230	363	2.05	2.36	22,300	A.
September	330	215	255	1.44	1.61	15,200	A.
October	875	330	573	3.24	3.74	35,200	A.
November	500	295	433	2.45	2.73	25,800	A.
December	260	.....	193	1.09	1.26	11,900	B.
The year	1,710	.....	511	2.88	39.25	371,000	

NOTE.—Mean discharges for January and February estimated by comparison with other St. Mary stations. Mean discharge for Mar. 1 to 12 estimated at 120 second-feet.

ST. MARY RIVER BELOW SWIFTCURRENT CREEK, AT BABB, MONT.

This station, which was established May 13, 1910, for the purpose of collecting run-off data for use in connection with the St. Mary irrigation project, is located at Babb below the mouth of Swiftcurrent Creek and about 3 miles below Lower St. Mary Lake. No water is diverted above the station, but the United States Reclamation Service has appropriated 850 second-feet of water, which will be diverted near the outlet of Lower St. Mary Lake.

Discharge measurements are made from a cable or by wading. In 1910 measurements were made from a footbridge at the station. The gage which was installed when the station was established was located on the left bank opposite the post office at Babb. It was an ordinary staff nailed to an old bridge pier. On July 19, 1911, a chain gage was installed on the right bank below the old gage, and at a different datum. A gaging station was maintained at this point from July, 1901, to November, 1902, but the gage was set at a different datum. The town was then called Main.

Discharge measurements of St. Mary River below Swiftcurrent Creek, at Babb, Mont., 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 13	W. A. Lamb	145	398	6.40	2,050
June 10	M. E. McChristie	149	400	6.20	1,930
25	W. A. Lamb	148	338	5.78	1,460
Aug. 1	M. E. McChristie	141	233	4.70	795
Sept. 15	.....do	106	169	3.82	312
Nov. 19	W. A. Lamb	125	196	4.55	681
Dec. 29	B. E. Jones	94	55	*a* 3.38	115

a Small amount of ice at gage.

Daily gage height in feet of St. Mary River below Swiftcurrent Creek, at Babb, Mont., for 1910.

[C. E. Hayes, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.60	5.90	4.72	3.85	4.50	4.70	4.00
2	.....	6.65	5.85	4.62	3.80	4.90	4.70	4.00
3	.....	6.60	5.85	4.60	3.80	5.20	4.60	4.00
4	.....	6.40	5.80	4.55	3.80	5.20	4.50	4.00
5	.....	6.30	5.75	4.60	3.80	5.20	4.40	3.90
6	.....	6.20	5.70	4.45	3.80	5.20	4.30	3.90
7	.....	6.20	5.60	4.25	3.80	5.30	4.40	3.90
8	.....	6.40	5.55	4.40	3.90	5.65	4.30	3.90
9	.....	6.30	5.50	4.45	3.90	5.80	4.30	3.90
10	.....	6.20	5.45	4.40	3.90	5.75	4.30	3.80
11	.....	6.20	5.40	4.40	3.90	5.70	4.40	3.80
12	.....	6.30	5.10	4.38	3.80	5.70	4.95	3.80
13	6.40	6.40	5.20	4.35	3.80	5.60	4.95	3.80
14	6.35	6.35	5.30	4.35	3.80	5.50	4.90	3.80
15	6.30	6.35	5.20	4.30	3.80	5.30	4.80	3.80
16	6.20	6.40	5.20	4.30	3.85	5.25	4.70	3.70
17	6.05	6.40	5.25	4.20	4.00	4.95	4.60	3.70
18	5.90	6.45	5.30	4.20	4.00	4.90	4.50	3.70
19	6.05	6.35	5.30	4.20	4.20	4.80	4.50	3.70
20	6.00	6.30	5.25	4.10	4.50	4.70	4.50	3.70
21	5.95	6.25	5.20	4.10	4.50	4.60	4.50	3.70
22	5.80	6.15	5.25	.....	4.50	4.50	4.40	3.70
23	5.90	6.00	5.20	.....	4.40	4.40	4.40	3.70
24	5.95	5.85	5.05	.....	4.30	4.30	4.30	3.70
25	6.40	5.95	5.00	.....	4.35	4.50	4.30	3.60
26	6.55	5.90	5.05	4.10	4.25	5.10	4.20	3.60
27	6.60	5.90	4.95	4.00	4.20	5.10	4.20	3.60
28	6.55	5.95	4.85	3.95	4.20	5.00	4.20	3.50
29	6.60	5.95	4.80	3.85	4.20	4.90	4.10	3.40
30	6.60	5.90	4.75	3.90	4.20	4.80	4.10	3.40
31	6.65	.....	4.70	3.90	.....	4.80	.....	3.30

NOTE.—Gage heights affected by ice Dec. 24 to 31.

Daily discharge, in second-feet, of St. Mary River below Swiftcurrent Creek, at Babb, Mont., for 1910.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2,200	1,560	782	322	655	770	395
2	.....	2,240	1,520	722	300	895	770	395
3	.....	2,200	1,520	710	300	1,100	710	395
4	.....	1,960	1,460	682	300	1,100	655	395
5	.....	1,920	1,430	710	300	1,100	606	345
6	.....	1,850	1,390	628	300	1,100	545	345
7	.....	1,850	1,320	520	300	1,170	600	345
8	.....	2,000	1,300	600	345	1,440	545	345
9	.....	1,910	1,260	628	345	1,560	545	345
10	.....	1,820	1,220	600	345	1,520	545	300
11	.....	1,820	1,200	600	345	1,480	600	300
12	.....	1,900	1,000	589	300	1,480	928	300
13	2,050	2,000	1,070	572	300	1,400	928	300
14	2,000	1,940	1,030	572	300	1,320	895	300
15	1,940	1,940	1,060	545	300	1,170	830	300
16	1,860	1,960	1,060	545	322	1,140	770	255
17	1,740	1,960	1,100	495	395	928	710	255
18	1,620	2,020	1,130	495	395	895	655	255
19	1,730	1,940	1,130	495	495	830	655	255
20	1,680	1,900	1,100	445	655	770	655	255
21	1,640	1,850	1,070	445	655	710	655	255
22	1,520	1,760	1,100	445	655	655	600	255
23	1,600	1,640	1,070	445	600	600	600	255
24	1,640	1,520	980	445	545	545	545	255
25	2,030	1,620	950	445	572	655	545	210
26	2,160	1,560	985	445	520	1,030	495	210
27	2,200	1,560	928	395	495	1,030	495	210
28	2,160	1,600	862	370	495	960	495	170
29	2,200	1,600	830	322	495	895	445	130
30	2,200	1,560	800	345	495	830	445	130
31	2,240	.....	770	345	.....	830	.....	95

NOTE.—Daily discharge computed from a fairly well-defined rating curve. From May 13 to July 26 the rating was applied indirectly. Discharge interpolated from Aug. 22 to 25.

Monthly discharge of St Mary River below Swiftcurrent Creek, at Babb, Mont., for 1910.

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
May 13-31	2,240	1,520	1,910	6.41	4.53	72,000	B.
June	2,240	1,520	1,890	6.34	7.07	112,000	B.
July	1,560	770	1,140	3.83	4.42	70,100	B.
August	782	322	528	1.77	2.04	32,500	A.
September	655	300	416	1.40	1.56	24,800	A
October	1,560	545	1,030	3.46	3.99	63,300	A.
November	928	445	641	2.15	2.40	38,100	A.
December	395	95	276	.926	1.07	17,000	B.
The period						430,000	

ST. MARY RIVER NEAR CARDSTON, ALBERTA.

This station was established September 4, 1902, near Shaw's ranch, one-fourth mile north of the boundary line between the United States and Canada and 17 miles south of Cardston, Alberta, for the purpose of obtaining data for use in connection with irrigation projects in the Milk River valley.

The station is 6 miles below the mouth of Kennedy Creek, the last tributary entering from the United States. With the exception of the area drained by Boundary Creek, a small stream entering a short distance above the station, the drainage basin lies within the United States. The total area drained is 452 square miles.

The only diversion above the station is that which will be made at Babb by the United States Reclamation Service in connection with the Milk River project. About 850 second-feet of water will be diverted into the Milk River drainage basin.

The chain gage was originally located about 1,200 feet above the cable. This gage was destroyed during the high water of June, 1908, and a new chain gage was installed July 17, 1908, about one-fourth mile below the cable. There is no determined relation between the gages. An auxiliary staff gage, with the same datum as the chain gage, was established October 14, 1909, and was used during low water. Results at this station are affected by shifting channel and heavy ice during the winter months.

Discharge measurements are made from the cable or by wading.

Discharge measurements of St. Mary River near Cardston, Alberta, 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 20	W. A. Lamb	109	349	2.85	1,240
May 13	do	110	483	4.15	2,450
June 10	M. E. McChristie	111	455	3.90	2,220
24	W. A. Lamb	108	388	3.32	1,640
July 31	M. E. McChristie	103	280	1.98	793
Sept. 14	do	100	206	1.06	374
Nov. 19	B. E. Jones	104	267	1.93	700
20	W. A. Lamb	103	266	1.90	698
Dec. 29	B. E. Jones	94	162	(a)	134

a Gage height affected by ice.

Daily gage height, in feet, of St. Mary River near Cardston, Alberta, for 1910.

[Mrs. H. F. Cook, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.85	3.6	4.7	3.3	2.0	1.1	2.3	1.9	1.5
2	.....	1.8	3.3	4.7	3.25	1.95	1.05	2.5	1.9	1.4
3	.....	1.75	3.2	4.6	3.2	1.95	1.1	2.5	1.9	1.4
4	.....	1.75	3.2	4.55	3.15	1.85	1.05	2.6	1.9	1.3
5	.....	1.55	3.15	4.25	3.05	1.85	1.05	2.5	1.85	1.1
6	.....	1.7	.....	4.0	3.0	1.8	1.05	2.6	1.9	1.1
7	.....	1.7	3.4	4.0	2.85	1.75	1.1	2.6	1.9	1.1
8	.....	1.8	4.2	4.3	2.85	1.8	1.05	2.8	1.9	1.1
9	.....	1.9	4.6	4.2	2.8	1.8	1.1	2.9	1.7	1.1
10	.....	2.1	4.5	3.9	2.7	1.75	1.05	2.9	1.8	1.1
11	.....	2.15	4.4	4.0	2.6	1.75	1.05	3.1	.....	1.2
12	.....	2.3	4.2	4.1	2.55	1.7	.....	3.1	.....	1.2
13	.....	2.55	4.2	4.1	2.6	1.7	.....	.....	2.5	1.15
14	3.0	2.3	4.15	4.1	2.6	1.7	1.1	.....	2.5	.....
15	2.9	2.5	4.15	4.1	2.55	1.65	1.05	2.6	2.3	.....
16	2.6	2.4	3.9	4.1	2.6	1.6	1.25	2.5	2.3	1.1
17	2.0	2.45	3.6	4.15	2.55	1.55	1.55	2.5	2.2	1.0
18	1.9	2.5	3.55	4.2	2.6	1.6	1.6	2.4	2.0	1.0
19	1.9	2.7	3.8	4.15	2.6	1.5	1.6	2.3	1.9	1.0
20	1.8	3.0	3.6	4.0	2.55	1.45	1.45	2.1	1.8	1.0
21	1.7	3.1	3.5	3.9	2.55	1.4	1.65	2.1	2.0	1.1
22	1.9	3.1	3.45	3.8	2.45	1.35	1.9	2.0	2.0	1.1
23	.....	3.05	.....	3.55	2.5	1.3	.....	1.9	2.0	1.1
24	2.0	3.05	4.5	3.3	2.45	1.2	.....	.....	2.1	.....
25	1.9	3.2	4.55	3.35	2.45	1.05	2.0	2.0	2.0	.....
26	1.9	3.7	4.6	3.35	2.4	1.05	2.05	2.3	2.0	.....
27	2.0	4.7	4.7	3.4	2.25	1.0	2.1	2.3	1.9	.....
28	1.9	4.35	4.7	3.4	2.2	1.05	2.1	2.3	1.9	.....
29	1.9	4.3	4.7	3.35	2.05	1.1	2.2	2.25	1.9	.....
30	1.9	4.0	4.7	3.25	2.05	1.05	2.15	.....	1.7	.....
31	1.9	.....	4.7	.....	2.0	1.1	.....	1.9	.....	.....

NOTE.—Relation of gage height to discharge probably affected by ice about Jan. 1 to Mar. 13 and Dec. 10 to 31.

Daily discharge, in second-feet, of St. Mary River near Cardston, Alberta, for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	667	1,970	2,960	1,640	803	394	969	696	505
2	.....	643	1,720	2,960	1,600	777	374	1,090	696	461
3	.....	620	1,640	2,860	1,560	777	394	1,090	691	461
4	.....	620	1,640	2,810	1,530	726	374	1,150	691	418
5	.....	528	1,610	2,540	1,450	726	374	1,090	667	338
6	.....	596	1,700	2,310	1,420	701	374	1,150	687	338
7	.....	596	1,800	2,310	1,310	677	394	1,150	687	338
8	.....	643	2,490	2,580	1,310	701	374	1,270	682	338
9	.....	691	2,860	2,490	1,280	701	394	1,340	588	338
10	.....	790	2,770	2,220	1,210	677	374	1,330	634	.....

Daily discharge, in second-feet, of St. Mary River near Cardston, Alberta, for 1910—Con.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	816	2,670	2,310	1,150	677	374	1,470	760	.....
12	.....	896	2,490	2,390	1,120	653	380	1,470	885	.....
13	.....	1,040	2,490	2,380	1,150	653	387	1,350	1,010	.....
14	1,340	896	2,440	2,370	1,150	653	394	1,240	1,010	.....
15	1,270	1,010	2,440	2,360	1,120	630	374	1,120	896	.....
16	1,070	952	2,220	2,350	1,150	606	454	1,060	896	.....
17	740	982	1,760	2,390	1,120	584	584	1,060	842	.....
18	691	1,010	1,920	2,430	1,150	606	606	1,000	740	.....
19	691	1,140	2,130	2,370	1,150	561	606	940	691	.....
20	643	1,340	1,760	2,230	1,120	539	539	825	643	.....
21	596	1,420	1,880	2,130	1,120	517	630	825	740	.....
22	691	1,420	1,840	2,040	1,060	496	751	767	740	.....
23	716	1,380	2,300	1,820	1,090	475	768	716	740	.....
24	740	1,380	2,770	1,640	1,060	434	785	738	790	.....
25	691	1,490	2,810	1,670	1,060	374	803	761	740	.....
26	691	1,900	2,860	1,670	1,030	374	830	922	740	.....
27	740	2,820	2,960	1,710	940	355	857	918	691	.....
28	691	2,530	2,960	1,710	912	374	857	918	691	.....
29	691	2,520	2,960	1,670	830	394	912	894	691	.....
30	691	2,290	2,960	1,600	830	374	884	798	596	.....
31	691	.....	2,960	.....	803	394	.....	701	.....	.....

NOTE.—Daily discharge computed by shifting channel method, giving each discharge measurement made during the year full weight. Standard curve used is well defined between gage heights 1.0 foot and 5.5 feet.

Daily discharge Mar. 1 to 13, and Dec. 10 to 31 estimated, because of ice, on basis of climatological records and discharge at other stations in St. Mary River drainage basin.

Mean discharge Mar. 1 to 13 estimated 180 second-feet.

Mean discharge Dec. 10 to 31 estimated about 254 second-feet, varying from 120 to 320 second-feet.

Daily discharge interpolated for other days when gage was not read.

Monthly discharge of St. Mary River near Cardston, Alberta, for 1910.

[Drainage area, 452 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	150	0.332	0.38	9,220	D.
February	.....	.....	160	.354	.37	8,890	D.
March	.....	.....	530	1.17	1.35	32,600	C.
April	2,820	528	1,190	2.63	2.93	70,800	A.
May	2,960	1,610	2,320	5.13	5.91	143,000	A.
June	2,960	1,600	2,240	4.96	5.53	133,000	A.
July	1,640	803	1,170	2.59	2.99	71,900	A.
August	803	355	580	1.28	1.48	35,700	A.
September	912	374	553	1.22	1.36	32,900	A.
October	1,470	701	1,040	2.30	2.65	64,000	A.
November	1,010	588	742	1.64	1.83	44,200	A.
December	505	.....	293	.648	.75	18,000	C.
The year	.....	.....	917	2.03	27.52	664,000	

NOTE.—Monthly discharge, January and February, estimated by means of comparisons with discharge at other stations in St. Mary River drainage basin.

See footnotes to table of daily discharge for other periods estimated.

SWIFTCURRENT CREEK NEAR BABB, MONT.

This station, which is located about 1 mile from the mouth of the stream, at a point where it leaves the foothills, and about 2 miles south of Babb, was established April 8, 1902, to obtain data for use in connection with irrigation projects on the Blackfoot Indian Reservation and in the Milk River valley.

No water is diverted or stored above this station. The construction of storage reservoirs is, however, feasible, and because of the great fall of the stream considerable power could be developed. Although the current is swift the flow during the winter months is to some extent affected by ice.

Discharge measurements are made from a cable or by wading. The cable has been located at different positions since the station was first established. Low-water measurements are made by wading near the gage.

The first gage was destroyed by high water in June, 1902, and the station was reestablished July 30, 1902, at a point 1,800 feet above the first gage. It was again moved September 27, 1902, to a point about 900 feet farther upstream and set at a different datum. At this location it remained until it was destroyed by the flood of June 5, 1908. July 26, 1908, the gage was reestablished, with a new datum, about 100 feet above its former location and 400 feet above the present cable.

This station was discontinued May 13, 1910, when a new station was established on St. Mary River below Swiftcurrent Creek. The difference between the records at this station and that of the St. Mary near Babb will indicate the flow of Swiftcurrent Creek.

The following discharge measurement was made by W. A. Lamb:

April 21: Width, 85 feet; area of section, 140 square feet; gage height, 3.75 feet; discharge, 682 second-feet.

Daily gage height, in feet, and discharge, in second-feet, of Swiftcurrent Creek near Babb, Mont., for 1910.

[Chas. E. Hayes, observer.]

Day.	Mar.		Apr.		May.		Day.	Mar.		Apr.		May.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.		Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1	.....	.....	2.8	165	3.5	520	16	2.6	110	3.25	370	.....	.....
2	.....	.....	2.7	130	3.4	460	17	2.6	110	3.25	370	.....	.....
3	.....	.....	2.7	130	3.25	370	18	2.7	130	3.25	370	.....	.....
4	.....	.....	2.7	130	3.2	340	19	2.7	130	3.4	460	.....	.....
5	.....	.....	2.7	130	3.25	370	20	2.8	165	3.7	670	.....	.....
6	.....	.....	2.8	165	3.4	460	21	3.0	240	3.8	750	.....	.....
7	.....	.....	2.8	165	3.7	670	22	3.1	290	3.65	630	.....	.....
8	.....	.....	2.8	165	4.1	1,030	23	3.2	340	3.5	520	.....	.....
9	.....	.....	2.8	165	4.2	1,140	24	3.1	290	3.5	520	.....	.....
10	.....	.....	3.1	290	4.1	1,030	25	3.1	290	3.7	670	.....	.....
11	.....	.....	3.2	340	3.9	840	26	3.0	240	3.95	890	.....	.....
12	.....	.....	3.3	400	3.75	710	27	2.9	205	4.1	1,030	.....	.....
13	2.5	90	3.4	460	3.65	630	28	2.9	205	4.1	1,030	.....	.....
14	2.5	90	3.4	460	.....	.....	29	2.8	165	3.95	890	.....	.....
15	2.5	90	3.35	430	.....	.....	30	2.8	165	3.7	670	.....	.....
							31	2.8	165	.....	.....	.....	.....

NOTE.—Discharge computed from a rating curve fairly well defined.

Monthly discharge of Swiftcurrent Creek near Babb, Mont., for 1910.

[Drainage area, 101 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January			40	0.396	0.46	2,460	D.
February			45	.446	.46	2,500	D.
March			135	1.34	1.54	8,300	C.
April	1,030	130	452	4.47	4.99	26,900	B.
May 1–13	1,140	340	659	6.52	3.15	16,900	B.

NOTE.—Mean discharge for January and February estimated. Mean discharge for Mar. 1–12 estimated at 55 second-feet.

RED RIVER.

GENERAL FEATURES OF AREA DRAINED.

Red River rises in Minnesota, its most remote source being a small lake near the southwest corner of Clearwater County, about 13 miles west of Lake Itasca, at an elevation of about 1,550 feet above sea level. From this lake it flows southward 60 miles (measured in a direct line) through a succession of small lakes to Ottertail Lake (elevation about 1,320 feet), thence westward 42 miles to Breckenridge, Minn., and Wahpeton, N. Dak. (elevation 943 feet); from this point it runs northward 285 miles (measured in a direct line) to the southern end of Lake Winnipeg, passing the Canadian boundary at Pembina at a distance of 190 miles and the city of Winnipeg at about 250 miles. On account of the meandering of the river the length of its channel is nearly double the length of the direct line.

Lake Winnipeg is about 250 miles long, and from its north end Nelson River flows northeastward 400 miles to Hudson Bay.

The upper part of Red River is called Ottertail River, that name being variously applied down as far as Ottertail Lake, Fergus Falls, or exceptionally to Breckenridge and Wahpeton as a lower limit; the portion flowing northward from Wahpeton to Lake Winnipeg is universally called Red River.

The upper course of Red River lies in that region of many lakes known as the park region of Minnesota. In Ottertail County there are more than 1,000 lakes, the largest being Ottertail Lake itself, which is 8 miles long and 2½ miles in average width. Many of these lakes have no visible outlet except during high water. In this portion of the drainage basin the country is a rolling prairie.

Although the main branch of Red River is Ottertail River, the term Red River valley is applied to the valley of the Bois des Sioux rather than to that of the Ottertail and extends from Lake Traverse northward to Lake Winnipeg. This valley is a plain from 30 to 50

miles wide and 315 miles long. As the elevation of Lake Traverse is 970 feet and that of Lake Winnipeg 710 feet, the fall of the valley in the entire distance is 260 feet or considerably less than 1 foot per mile. Lake Traverse is 15 miles long and from 1 to 1½ miles wide and is shallow, being for the most part less than 10 feet in depth; it is bordered on either side by bluffs rising from 100 to 150 feet above the lake level. Those bluffs continue on each side of Browns Valley to Big Stone Lake, where they have the same height. During the glacial epoch Red River valley was occupied by an immense lake, now called Lake Agassiz, which had its outlet through Browns Valley into Big Stone Lake and through the present Minnesota Valley. At the present time there is water connection between the two lakes during periods of very high water, as the watershed between the two is a marsh that is only 3 feet above Lake Traverse and 11 feet above Big Stone Lake.

In addition to the gentle northward slope of the valley, there is a gentle slope toward the center from each side. In this axial depression Red River has cut a channel 20 to 60 feet deep. Between the drainage lines of the tributaries, which cross the valley at right angles to the river, there are areas from 5 to 15 miles wide that have no watercourses.

The entire area is covered with a sheet of blue till, consisting of a mixture of sand, clay, and gravel. The portion of the basin formerly occupied by Lake Agassiz is covered with a deposit of lacustrine clay. The basin is underlain by Cretaceous rocks. In one of these rocks, the Dakota sandstone, is found the source of the artesian water in North and South Dakota. In the lower portion of the valley, especially in Kittson County, salt water is found not only in the gravel beds of the glacial drift, but also in the underlying rock; much of the surface water is also permeated by salt.

At the margins of the Red River drainage basin elevations range between 1,200 and 1,600 feet, but the boundaries are not precisely defined. Along much of the eastern side the country is so level that many swamps and marshes drain with equal facility to either side; along the western side there are wide belts whose drainage systems were destroyed by the accumulation of drift and moraines left by the ice of the glacial epoch, and in these belts the surface water collects in innumerable hollows, kettle holes, and sloughs, and stands till it evaporates. If the rainfall were greater these many sink holes and lakelets would overflow and natural erosion would perfect the drainage system.

The following drainage areas have been measured in the basin:

Drainage areas in Red River basin.

River.	Drainage area above—	Square miles.
Ottertail	Pine Lake outlet	690
Do	Ottertail Lake outlet	1,160
Do	Sec. 19, T. 134 N., R. 42 W	1,310
Do	Fergus Falls	1,360
Red	Sec. 6, T. 132 N., R. 43 W	1,800
Do	Fargo	6,020
Do	Grand Forks	25,000
Do	International boundary	34,300
Pelican	Mouth	450
Bois des Sioux	Lake Traverse outlet	1,110
Do	Mouth	1,740
Buffalo	South Fork	573
Do	Mouth	1,400
Sand Hill	do	535
Snake	do	1,040
Middle River	do	397
Tamarack	do	578

East of a north-south line drawn about 50 miles east of the main Red River the whole country is heavily timbered; west of such a line it is open prairie, treeless except along the streams.

The mean annual rainfall of the Red River drainage area increases uniformly from west to east, being 15 to 18 inches at the western boundary, 19 to 24 inches at stations in the middle of the valley, and 24 to 26 inches at the eastern boundary. Owing to the larger rainfall on the eastern side of the area the run-off per square mile from the tributaries on this side is from two to ten times as great as that on the west side. About 75 per cent of the total rainfall occurs in the six months from April 1 to September 30.

Drainage work is being carried on rapidly in this basin, especially in that portion lying in Minnesota. As a result, the following areas have been benefited by ditching:

Areas improved by drainage.

	Acres.		Acres.
Kittson County	222,000	Traverse County	89,000
Roseau County	160,000	Grant County	54,000
Norman County	164,000	Polk County	972,000
Clay County	262,000	Clearwater County	23,000
Wilkin County	196,000		
Ottertail County	27,000		2,170,000
Becker County	3,000		

The best reservoir site in the portion of the drainage basin drained by the principal river itself is Ottertail Lake, which has an area of about 22 square miles and receives the run-off from an area of 1,160 square miles.

During 1911 a topographic survey of this lake was made by the United States Geological Survey, which shows the possibilities of the lake as a reservoir.

A survey of Ottertail River from the dam at Phelps to a point several miles below the Dayton Hollow dams was made to determine the amount of power available on the river. From the data collected on this survey, sheets have been prepared showing a profile of the water surface, a plan of the river, and the topography adjacent to the river. The results of this survey have been published on separate sheets and may be had upon application to the district engineer, United States Geological Survey, Old Capitol Building, St. Paul, Minn. From this survey the following table of elevations and distances has been compiled:

Elevations and distances along Ottertail River.

Place.	Distance below Phelps Dam.	Elevation.
	Miles.	*Feet.*
Highway bridge, S. 26, T. 132 N., R. 44 W	51	1,035
Ottertail Power Co. tailwater	45	1,073
Ottertail Power Co. headwater	45	1,108
Pelican River	39	1,118
Township line 132–133 N	38	1,125
Red River Milling Co. tailwater	35	1,157
Red River Milling Co. headwater	35	1,167
Fergus Flour Mill tailwater	35	1,168
Fergus Flour Mill headwater	35	1,182
City Water Co. tailwater	34	1,185
City Water Co. headwater	34	1,198
Electric-power plant tailwater	32	1,203
Electric-power plant headwater	32	1,215
Northern Pacific Ry	28	1,232
United States Geological Survey gaging station	21	1,251
Range line 42–43 W	15	1,268
Outlet chain of ponds	13	1,287
Oliver Dam tailwater	9	1,298
Oliver Dam headwater	9	1,302
West Lost Lake outlet	6	1,303
Phelps Dam tailwater	0	1,309
Phelps Dam headwater	0	1,318

The following table of approximate elevations and distances has been compiled chiefly from the reports of the Minnesota Geological Survey:

Elevations and distances along Pelican River.

Place.	Miles above mouth.	Elevation.
		Feet.
Ottertail River	0	1,118
Carlisle (Great Northern Ry.)	4	1,149
Elizabeth tailwater	11	1,215
Elizabeth headwater	11	1,228
Erhard	18	1,268
Pelican Rapids (Great Northern Ry.)	23	1,280
Pelican Rapids tailwater	25	1,289
Pelican Rapids headwater	25	1,301
Lake Lizzie outlet	30	1,315
Pelican Lake outlet	31	1,320
Lake Melissa outlet	40	1,330
Detroit Lake outlet	46	1,335
Lake Elsa outlet	51	1,345

Water power is developed at the following points:

Developed water powers in Red River basin.

Place.	Stream.	Fall utilized.	Average horsepower.
		Feet.	
Maine Mills	Ottertail River	8	50
Fergus Falls	do	65	860
Dayton Hollow	do	36	250
Lakeview	Pelican River		50
Kingsbury	do	11	30
Pelican Rapids	do	12	100
Elizabeth	do	13	100
Richwood	Buffalo River	11	40
Fertile	Sand Hill River	15	50

Red River is navigable from Grand Forks down to Winnipeg. Theoretically it is navigable from Grand Forks up to Breckenridge except during low water, but in recent years there has been no traffic except in the lower 25 miles of this stretch, and many fixed bridges have been cheaply built, practically closing it to navigation.

Records of discharge have been maintained in the upper portion of the basin since 1899. These records show that the driest year was 1910 and the wettest 1906. The ratio of flow during these two years was 1 to 3.09.

The records of the gaging stations in this area provide data of value in determining the seasonal or total flow of the whole river or any of its tributaries, information necessary in studies of navigation and the prevention of flood damage, water-power development, and drainage.

Water storage on Red River and its tributaries has been made the subject of an investigation by the United States Engineer Corps, the results being published in House Document 127, Fifty-second Congress, first session, and House Document 539, Fifty-eighth Congress, second session.

The quality of the water in Red River has been examined by the United States Geological Survey in connection with a general study of the quality of surface waters in Minnesota. The results of the investigation have been published by the Survey as Water-Supply Paper 193.

OTTERTAIL RIVER NEAR FERGUS FALLS, MINN.

This station, which was established May 9, 1904, is located at Three-mile Bridge, about 3¼ miles northeast of Fergus Falls, Minn., on the line between secs. 18 and 19, T. 133 N., R. 42 W.; because of the loop in the river, however, this point is 8 miles up the valley from Fergus Falls. The gage is attached to the bridge and discharge measurements are made at the same section.

The records furnish information of especial value in connection with the future development of water power, for which this stream is particularly available.

The nearest tributary is the outlet of Wall Lake, which enters Ottertail River several miles below the station. Twenty miles above the station is Ottertail Lake, about 22 square miles in area, through which the river flows and by which its flow is so well regulated that the recorded range of stage has not exceeded 2 feet. On the upper part of the river there are a number of logging dams used to drive logs to the sawmill at Frazee, but there are none between the lowest logging dam at Frazee and the dam at Maine, several miles below Ottertail Lake, in about sec. 35, T. 134, R. 41. During the low-water season, the closing of the turbine gates at Maine may affect the flow immediately below the dam, but the small lakes through which the river flows before reaching the gaging station serve to equalize the flow at the latter point. Below this station there are a number of power plants, but owing to the fall of the river the operation of the plants produces no effect at the gage.

There have been no changes in either gage datum or discharge curve since the station was established. The records are affected to some extent by the use of incorrect chain length and staff gages when the chain gage was out of commission. From December to March the river is frozen over and occasional discharge measurements are made through the ice to determine the winter flow.

The records at this station and those at the outlet of Ottertail Lake furnish 12 years' record of flow of the river below Ottertail Lake.

The United States Engineer Office maintained a gaging station on Ottertail River at the outlet of Ottertail Lake from May 1, 1899, to May 14, 1904. As there is no important tributary between, these records are almost directly comparable with those of the Geological Survey given herewith, the difference in drainage area being about 12 per cent.

The daily discharge and monthly estimates for all years prior to 1910, inclusive, have been republished in "Report of water resources investigation of Minnesota during 1909–10," by the State drainage commission, St. Paul, Minn.

Discharge measurements of Ottertail River near Fergus Falls, Minn., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 21	E. F. Chandler	90	90.0	[a] 4.08	219
July 16	Robert Follansbee	90	104	2.60	167
Aug. 23[b]	do	54	38.7	2.14	48.1
Dec. 23	C. R. Adams	85	49.1	[c] 3.17	85.2

[a] Gage height to water surface; thickness of ice approximately 1.7 feet.
[b] Wading measurement.
[c] Gage height to water surface; thickness of ice 1.2 feet.

Daily gage height, in feet, of Ottertail River near Fergus Falls, Minn., for 1910.

[H. G. Evensen, jr., observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.4	.....	3.2	3.3	3.1	2.8	2.35	2.1	2.0	2.3	.....
2	.....	.....	3.2	3.3	3.1	2.8	2.3	2.15	2.0	2.3	2.25
3	.....	.....	3.2	3.3	3.05	2.8	2.3	2.1	2.0	2.3	2.25
4	.....	.....	3.2	3.3	3.05	2.75	2.3	2.05	1.95	2.35	2.25
5	.....	.....	3.2	3.3	3.05	2.75	2.3	2.05	1.95	2.4	3.0
6	.....	.....	3.25	3.3	3.05	2.7	2.3	2.05	1.95	2.4	3.05
7	.....	.....	3.25	3.3	3.05	2.7	2.3	2.05	1.95	2.3	3.05
8	.....	.....	3.25	3.3	3.0	2.65	2.3	2.0	2.0	2.3	3.05
9	.....	.....	3.25	3.3	3.0	2.65	2.3	1.95	2.05	2.3	3.0
10	4.2	.....	3.25	3.3	3.0	2.65	2.3	1.95	2.05	2.3	3.0
11	.....	.....	3.25	3.3	3.0	2.65	2.25	1.95	2.05	2.3	.....
12	.....	.....	3.25	3.25	3.0	2.6	2.25	1.95	2.05	2.3	.....
13	.....	.....	3.25	3.25	3.0	2.6	2.25	1.9	2.0	2.3	.....
14	.....	3.25	3.25	3.25	3.0	2.6	2.25	2.0	2.05	2.3	3.0
15	.....	3.2	3.3	3.25	3.0	2.6	2.2	2.0	2.05	2.3	.....
16	.....	3.1	3.3	3.2	2.95	2.6	2.2	2.0	2.0	2.25	.....
17	.....	3.1	3.3	3.2	2.95	2.6	2.2	2.0	2.0	2.25	.....
18	4.5	3.05	3.3	3.2	2.9	2.6	2.2	2.0	2.0	2.25	.....
19	.....	3.05	3.3	3.2	2.9	2.55	2.2	2.0	2.1	2.25	.....
20	.....	3.05	3.3	3.2	2.9	2.55	2.25	2.0	2.1	2.25	.....
21	4.0	3.05	3.3	3.2	2.9	2.5	2.25	2.0	2.15	2.25	.....
22	.....	3.05	3.3	3.2	2.85	2.5	2.15	2.1	2.15	2.25	3.1
23	.....	3.0	3.3	3.2	2.85	2.5	2.15	2.1	2.25	2.25	.....
24	.....	3.0	3.3	3.2	2.85	2.45	2.05	2.0	2.3	2.25	.....
25	.....	3.0	3.3	3.2	2.85	2.45	2.05	2.15	2.3	2.2	.....
26	.....	3.0	3.3	3.15	2.85	2.4	2.05	2.2	2.35	2.2	.....
27	.....	3.0	3.3	3.15	2.8	2.4	2.05	2.0	2.35	2.2	.....
28	.....	3.05	3.3	3.15	2.8	2.35	2.05	2.0	2.3	2.2	.....
29	.....	3.05	3.3	3.15	2.8	2.35	2.05	2.0	2.3	2.2	3.2
30	.....	3.15	3.3	3.15	2.8	2.35	2.05	2.0	2.3	2.2	.....
31	.....	3.15	3.3	3.1	.....	2.35	2.05	.....	2.3	.....	.....

NOTE.—Ice from Jan. 1 to Mar. 14 and from Dec. 5 to 31.

Daily discharge, in second-feet, of Ottertail River near Fergus Falls, Minn., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	402	449	357	236	98	43	28	85	68
2	.....	.....	.....	402	449	357	236	85	52	28	85	74
3	.....	.....	.....	402	449	336	236	85	43	28	85	74
4	.....	.....	.....	402	449	336	218	85	36	22	98	74
5	.....	.....	.....	402	449	336	218	85	36	22	111	.....
6	.....	.....	.....	426	449	336	201	85	36	22	111	.....
7	.....	.....	.....	426	449	336	201	85	36	22	85	.....
8	.....	.....	.....	426	449	315	184	85	28	28	85	.....
9	.....	.....	.....	426	449	315	184	85	22	36	85	.....
10	.....	.....	.....	426	449	315	184	85	22	36	85	.....
11	.....	.....	.....	426	449	315	184	74	22	36	85	.....
12	.....	.....	.....	426	426	315	168	74	22	36	85	.....
13	.....	.....	.....	426	426	315	168	74	16	28	85	.....
14	.....	.....	426	426	426	315	168	74	28	36	85	.....
15	.....	.....	402	449	426	315	168	62	28	36	85	.....
16	.....	.....	357	449	402	294	168	62	28	28	74	.....
17	.....	.....	357	449	402	294	168	62	28	28	74	.....
18	.....	.....	336	449	402	274	168	62	28	28	74	.....
19	.....	.....	336	449	402	274	153	62	28	43	74	.....
20	.....	.....	336	449	402	274	153	74	28	43	74	.....
21	.....	*a*219	336	449	402	274	138	74	28	52	74	.....
22	.....	.....	336	449	402	255	138	52	43	52	74	.....
23	.....	.....	315	449	402	255	138	52	43	74	74	*a* 85
24	.....	.....	315	449	402	255	124	36	28	85	74	.....
25	.....	.....	315	449	402	255	124	36	52	85	62	.....
26	.....	.....	315	449	380	255	111	36	62	98	62	.....
27	.....	.....	315	449	380	236	111	36	28	98	62	.....
28	.....	.....	336	449	380	236	98	36	28	85	62	.....
29	.....	.....	336	449	380	236	98	36	28	85	62	.....
30	.....	.....	380	449	380	236	98	36	28	85	62	.....
31	.....	.....	380	.....	357	.....	98	36	.....	85	.....	.....

a Discharge measurement.

NOTE.—Discharge at this station computed from an excellent rating curve.

Monthly discharge of Ottertail River near Fergus Falls, Minn., for 1910.

[Drainage area 1,310 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	325	0.248	0.27	C.
February	.....	.....	240	.168	.17	C.
March	426	.....	285	.218	.25	B.
April	449	402	434	.331	.37	A.
May	449	357	417	.318	.37	A.
June	357	236	294	.224	.25	A.
July	236	98	163	.124	.14	A.
August	98	36	64.8	.049	.06	A.
September	52	16	32.6	.025	.03	A.
October	98	22	48.3	.037	.04	A.
November	111	62	79	.060	.07	A.
December	.....	.....	80	.061	.07	C.
The year	449	16	205	.156	2.09	

NOTE.—Mean discharge for January and February estimated. Mean discharge, Mar. 1 to 14, estimated, 200 second-feet; Dec. 5 to 31, 81second-feet.

RED RIVER NEAR FERGUS FALLS, MINN.

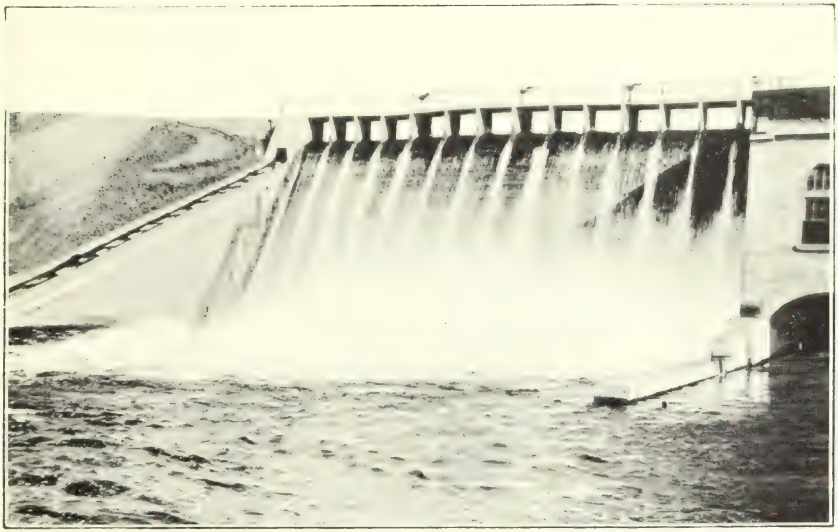
This station, which is located at Dewey Bridge, 3½ miles west of Fergus Falls and about 1 mile below the mouth of Pelican River, was established June 19, 1909, to obtain data for use in connection with water power development on Red River.

Except Pelican River no tributary enters within several miles of the station. The drainage area above this point is 1,800 square miles.

The nearest dam above the station is at Fergus Falls. Although the intermittent operation of the mills at this point may cause a daily fluctuation, its effect is very slight at the station, as there is no consistent difference between the recorded morning and evening gage heights. Three or four miles below the vertical staff gage at the bridge section is the Dayton Hollow dam, which is the control for the gaging section, as is shown by the drop in the gage heights when the water level above the dam is lowered for repairs to that structure. (See Pl. III, *A*.) When the station was established, it was believed that this control was reasonably permanent, but the data were so unsatisfactory that the station was discontinued March 31, 1910.

Discharge measurements are made from the bridge.

Owing to the short time that the station was operated, it was not completely rated; hence no estimate of daily flow can be given.



A. DAYTON HOLLOW DAM ON OTTERTAIL RIVER BELOW FERGUS FALLS, MINN

A typical modern power development.

B. MEASUREMENT OF RAINY RIVER AT INTERNATIONAL FALLS, MINN.

Daily gage height, in feet, of Red River near Fergus Falls, Minn., for 1910.

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1			7.29	11				21			5.48
2				12	6.99			22		7.21	5.51
3		7.12		13				23			5.47
4				14				24			5.42
5				15		6.99		25			5.44
6				16			7.40	26	7.12		5.48
7				17			7.48	27			5.51
8				18			6.17	28			5.42
9		7.22	7.35	19	6.91		5.90	29			5.45
10				20			5.65	30			5.51
								31			5.46

NOTE.—Ice from Jan. 1 to Mar. 15. The average thickness of ice during this period was 1.6 feet.

RED RIVER AT FARGO, N. DAK.

This station, which is located at the highway bridge connecting Front Street, Fargo, N. Dak., with Moorhead, Minn., was established May 23, 1901. Discharge measurements are made half a mile farther upstream, at the footbridge at the Fargo waterworks pumping station, except at very high stage, when the Front Street Bridge or the Northern Pacific Railway bridge is used.

The drainage area above this station is about 6,020 square miles, 3,770 being in Minnesota, 500 in South Dakota, and 1,750 in North Dakota. The nearest tributary is Sheyenne River, which enters Red River 10 miles below.

The vertical staff gage is attached to the breakwater for the center pier of the Front Street Bridge and is read from the bridge or the banks by the aid of a field glass.

The gage datum has not been changed since the establishment of the station. The channel is in clay and silt, and slight changes in depth occur from time to time. The fall is so slight that any accidental obstruction in the channel is likely to cause an appreciable effect for a long distance upstream and to affect the rating. Hence, unless frequent discharge measurements are made, slight errors will enter, but there have been no very great changes in the rating curves for nine years, and the records are fairly good except when affected by ice, by which the stream is smoothly closed for about four months of the year. At the spring break-up, on account of the comparatively sluggish current and the fact that the river flows northward into a colder district, a pronounced backwater effect is usually caused by ice jams and partial ice jams, and the river is raised disproportionately high for several days or weeks. At that season, therefore, the records can only be approximate unless daily discharge measurements are made.

The estimates of daily and monthly discharge for all years prior to 1910, inclusive, have been published in "Report of water resources investigation in Minnesota during 1909–10" by the State drainage commission, St. Paul, Minn.

Discharge measurements of Red River at Fargo, N. Dak., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq.ft.*	*Feet.*	*Sec.ft.*
July 27	E. F. Chandler	93	142	6.74	150
Aug. 16	.....do	95	163	5.98	56

Daily gage height, in feet, of Red River at Fargo, N. Dak., for 1910.

[H R. Grasse, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	9.4	11.6	11.0	8.8	7.7	6.6	5.9	6.0	5.7	5.4
2	.....	9.4	11.6	10.9	8.7	7.6	6.6	5.9	6.0	5.9	5.3
3	.....	9.4	11.4	10.9	8.6	7.5	6.6	5.9	5.9	6.0	5.7
4	.....	9.4	11.4	10.8	8.6	7.5	6.6	5.8	5.9	6.0	5.8
5	.....	9.5	11.4	10.7	8.5	7.5	6.3	5.8	5.9	5.8	6.0
6	.....	10.5	11.4	10.7	8.6	7.5	6.4	5.9	5.9	5.8	6.2
7	.....	11.5	11.3	10.6	8.6	7.4	6.5	5.9	5.9	5.9	.....
8	.....	11.8	11.1	10.6	8.6	7.4	6.5	5.8	5.9	6.0	.....
9	.....	11.8	11.0	10.5	8.5	7.3	6.5	5.8	5.9	6.0	.....
10	.....	11.9	11.0	10.5	8.5	7.1	6.4	5.8	5.9	6.2	.....
11	.....	12.8	10.9	10.4	8.5	7.0	6.4	5.8	5.9	6.2	.....
12	.....	13.6	11.7	10.4	8.4	7.0	6.3	5.8	5.9	6.2	.....
13	.....	15.3	11.6	10.4	8.4	7.0	6.4	5.8	5.9	6.2	.....
14	.....	17.8	11.5	10.4	8.4	7.0	6.4	5.8	5.95	6.1	.....
15	.....	19.5	11.5	10.0	8.3	7.0	6.4	5.9	5.95	6.2	.....
16	.....	21.2	11.5	9.8	8.2	7.2	6.0	5.9	6.0	6.2	.....
17	.....	22.3	11.0	9.7	8.3	7.2	6.0	5.9	6.0	6.3	.....
18	.....	23.0	10.5	9.7	8.4	7.1	6.0	5.8	6.0	6.4	.....
19	.....	23.1	10.5	9.7	8.1	7.1	6.1	5.8	6.0	6.3	.....
20	.....	22.9	10.5	9.6	8.0	7.0	5.9	5.8	6.3	6.1	.....
21	.....	21.7	10.6	9.5	7.9	6.9	6.0	5.8	6.2	6.1	.....
22	.....	20.2	10.9	9.5	7.9	6.8	6.1	5.9	6.4	6.1	.....
23	.....	18.3	12.7	9.5	7.9	6.9	5.8	5.8	6.1	6.3	.....
24	.....	16.0	13.0	9.4	7.8	6.9	6.0	5.8	6.2	6.4	.....
25	.....	14.3	12.9	9.3	7.8	6.8	6.1	5.8	6.2	6.5	.....
26	.....	13.3	12.5	9.3	7.8	6.7	6.1	5.9	6.0	6.3	.....
27	9.4	12.8	12.0	9.2	7.8	6.7	5.8	6.0	6.2	6.4	.....
28	9.4	12.5	11.8	9.0	7.8	6.7	6.1	6.0	5.8	6.5	.....
29	.....	12.3	11.5	9.0	7.8	6.6	6.2	6.0	5.6	6.5	.....
30	.....	12.0	11.1	9.0	7.8	6.6	6.1	6.0	5.6	6.5	.....
31	.....	11.8	.....	8.9	.....	6.6	5.9	.....	5.7	.....	.....

NOTE.—Ice present from Jan. 1 to Mar. 22 and from Nov. 9 to Dec. 31.

Daily discharge, in second-feet, of Red River at Fargo, N. Dak., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	270	1,470	1,280	635	356	131	51	60	36
2	270	1,470	1,250	608	332	131	51	60	51
3	270	1,400	1,250	582	309	131	51	51	60
4	270	1,400	1,220	582	309	131	43	51	60
5	290	1,400	1,190	556	309	90	43	51	43
6	520	1,400	1,190	582	309	102	51	51	43
7	790	1,370	1,160	582	286	116	51	51	51
8	850	1,310	1,160	582	286	116	43	51	60
9	820	1,280	1,120	556	264	116	43	51	.....
10	820	1,280	1,120	556	221	102	43	51	.....
11	1,070	1,250	1,090	556	201	102	43	51	.....
12	1,300	1,500	1,090	530	201	90	43	51	.....
13	1,850	1,470	1,090	530	201	102	43	51	.....
14	2,700	1,440	1,090	530	201	102	43	55	.....
15	3,300	1,440	969	504	201	102	51	55	.....

Daily discharge, in second-feet, of Red River at Fargo, N. Dak., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	3,800	1,440	911	478	242	60	51	60	.....
17	4,000	1,280	882	504	242	60	51	60	.....
18	4,300	1,120	882	530	221	60	43	60	.....
19	4,500	1,120	882	453	221	69	43	60	.....
20	4,700	1,120	853	428	201	51	43	90	.....
21	4,600	1,160	824	404	182	60	43	79	.....
22	4,400	1,250	824	404	164	69	51	102	.....
23	4,100	1,850	824	404	182	43	43	69	.....
24	3,100	1,960	797	380	182	60	43	79	.....
25	2,440	1,920	770	380	164	69	43	79	.....
26	2,070	1,780	770	380	147	69	51	60	.....
27	1,890	1,600	743	380	147	43	60	79	.....
28	1,780	1,530	689	380	147	69	60	43	.....
29	1,710	1,440	689	380	131	79	60	30	.....
30	1,600	1,310	689	380	131	69	60	30	.....
31	1,532	.....	662	.....	131	51	.....	36	.....

NOTE.—Daily discharge computed from well-defined rating curve except from Mar. 1 to 22, when the discharge was estimated.

Monthly discharge of Red River at Fargo, N. Dak., for 1910.

[Drainage area, 6,020 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
March	.....	.....	2,130	0.354	0.41	131,000	C.
April	1,960	1,120	1,430	.238	.27	85,100	A.
May	1,280	662	967	.161	.19	59,500	A.
June	635	380	491	.081	.09	29,200	B.
July	356	131	220	.037	.04	13,500	B.
August	131	43	85.3	.014	.02	5,240	B.
September	60	43	47.9	.0080	.009	2,850	B.
October	102	30	58.3	.0097	.01	3,580	B.
November	.....	.....	[a] 45.0	.0075	.008	2,680	C.
The period	.....	.....	.....	.....	.....	332,650	

[a] Mean discharge, Nov. 9 to 30, estimated 43 second-feet.

RED RIVER AT GRAND FORKS, N. DAK.

This station, which is located at the Northern Pacific Railway bridge between Grand Forks, N. Dak., and East Grand Forks, Minn., was established May 26, 1901. Gage-height records had, however, been kept by the United States Army engineers for many years at this point, their staff gage being located on the breakwater to which the original United States Geological Survey gage was attached, but at a datum 5.00 feet higher. A chain gage later installed on the downstream side of the bridge at the same datum has remained unchanged since the establishment of the station.

Discharge measurements are usually made from the Great Northern Railway bridge about 1,000 feet above the chain gage. The chain

gage is one-half mile below the mouth of Red Lake River. The drainage area at this station includes about 13,400 square miles in Minnesota, 500 in South Dakota, and 11,100 in North Dakota, a total of 25,000 square miles. Red Lake River, which drains 5,680 square miles of the total area, is much more steady in its flow than Red River, so that at low stages (in winter, and often in late summer and fall) Red Lake River brings from one-half to three-fifths of all the water passing this station.

The channel is cut in clay and silt and is subject to small gradual changes, but unusually precise gage records have been kept; the range of the river in height is so great—47 feet between the extremes of low and high water—that a change of 0.1 foot in gage height causes only a small percentage change in flow, and as frequent discharge measurements have been made the records are satisfactory, being as a rule excellent through the open season.

The river flows under smooth ice from about November 15 to April 10; the flow during the winter fluctuates little, and since 1895 enough discharge measurements have been made each winter to give fairly satisfactory summaries for the winter.

When the ice breaks up in the spring, because the river has only a gentle current and because it flows north into cooler regions where the river is not yet open, the gage reading is usually excessively and disproportionately high for a few days or weeks, so that the figures for quantity of flow must depend largely on estimation; actual measurements when the river appeared entirely open and clear of ice at this point have sometimes shown the gage reading to be 5 feet greater than would have been needed for the same discharge later in the season, after the whole length of the river was entirely open.

The daily and monthly discharge estimates for all years prior to 1910, inclusive, have been published in "Report of water resources investigation of Minnesota during 1909–10," by the State drainage commission, St. Paul, Minn.

Discharge measurements of Red River at Grand Forks, N. Dak., 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 14	J. O. Nomland	215	1,300	[a] 8.77	1,530
Feb. 28	do	208	897	[b] 7.67	983
Mar. 23	E. F. Chandler	543	7,580	30.17	18,300
July 25	do	128	621	5.12	830
Aug. 20	do	115	384	3.39	366
Oct. 14	do	70	319	3.36	395
Dec. 13	Chandler and Ebner	73	253	[c] 3.74	312

[a] Gage height to water surface; thickness of ice, 1.10 feet.
[b] Gage height to water surface; thickness of ice, 1.80 feet.
[c] Gage height to water surface; thickness of ice, .95 foot.

Daily gage height, in feet, of Red River at Grand Forks, N. Lak., for 1910.

[H. L. Hayes, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	9.50	.....	.....	18.20	17.80	8.95	5.98	4.65	3.60	3.50	3.38	3.62
2	.....	.....	.....	18.48	16.95	8.69	5.88	4.68	3.35	3.45	3.68	3.68
3	.....	.....	.....	18.30	16.20	8.70	5.72	4.48	3.25	3.50	3.52	3.70
4	.....	.....	.....	18.25	15.45	8.78	5.62	4.40	3.40	3.45	3.60	.....
5	.....	8.90	8.90	17.95	14.80	8.80	5.65	4.42	3.60	3.60	3.00	.....
6	.....	.....	.....	17.62	14.45	8.89	5.60	4.30	3.98	3.50	3.18	.....
7	.....	.....	.....	17.35	13.90	8.81	5.50	4.22	4.20	3.35	2.70	.....
8	9.10	.....	.....	16.95	13.50	8.78	5.40	4.30	3.75	3.25	3.22	.....
9	.....	.....	.....	16.55	12.92	8.75	5.42	4.16	3.70	3.12	3.30	.....
10	.....	.....	.....	16.18	12.55	8.60	5.42	3.75	3.70	3.62	3.40	3.10
11	.....	.....	.....	15.70	12.00	8.45	5.40	4.38	3.65	3.62	3.52	.....
12	.....	8.92	.....	15.32	11.90	8.20	5.38	3.97	3.66	3.65	3.10	.....
13	.....	.....	13.50	14.70	11.65	8.25	5.20	3.92	3.55	3.50	3.42	3.70
14	.....	.....	.....	13.98	11.39	8.18	5.05	4.00	3.62	3.35	3.40	.....
15	8.70	.....	.....	13.75	10.90	8.00	5.00	3.90	3.65	3.35	3.20	.....
16	.....	.....	.....	13.65	10.90	7.98	5.07	3.82	3.65	3.45	3.38	.....
17	.....	.....	.....	13.50	10.95	7.68	4.90	3.82	3.70	3.30	3.38	3.90
18	.....	.....	.....	13.22	10.85	7.52	4.88	3.82	3.95	3.65	3.30	.....
19	.....	8.60	28.50	13.15	10.80	7.35	4.92	3.62	3.45	3.25	3.38	.....
20	.....	.....	29.60	13.75	10.68	7.22	4.82	3.35	3.35	3.40	3.45	.....
21	.....	.....	30.55	15.25	10.50	7.10	4.80	3.50	3.25	3.25	3.45	.....
22	8.88	.....	30.70	17.05	10.40	6.95	4.78	3.50	3.35	3.58	3.42	.....
23	.....	.....	30.25	19.30	10.49	6.68	4.72	3.50	3.25	3.72	3.38	.....
24	.....	.....	29.40	20.25	10.42	6.50	5.05	3.50	3.92	3.75	3.40	4.10
25	.....	.....	29.25	20.40	10.08	6.45	5.15	3.45	3.19	3.65	3.75	.....
26	.....	8.10	26.45	20.52	9.92	6.38	5.16	3.45	3.75	3.80	3.80	.....
27	.....	.....	24.75	20.58	9.70	6.20	5.08	3.40	3.48	3.90	3.70	.....
28	.....	.....	22.60	20.15	9.52	6.19	4.98	3.30	3.35	3.68	3.68	.....
29	8.85	.....	20.20	19.35	9.42	6.10	4.96	3.30	3.48	3.65	3.60	.....
30	.....	.....	18.80	18.65	9.29	6.05	4.88	3.30	3.40	3.55	3.58	.....
31	.....	.....	18.28	.....	9.32	.....	4.80	3.45	.....	3.50	.....	4.20

NOTE.—Ice present from Jan. 1 to Mar. 25 and from Nov. 5 to Dec. 31.

Daily discharge, in second-feet, of Red River at Grand Forks, N. Dak., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	8,760	8,440	2,560	1,140	682	429	410	387
2	.....	8,990	7,760	2,420	1,100	691	382	400	445
3	.....	8,850	7,180	2,430	1,040	635	364	410	414
4	.....	8,800	6,610	2,470	1,000	613	391	400	429
5	.....	8,560	6,160	2,480	1,010	618	426	429	325
6	.....	8,290	5,920	2,530	995	587	510	410	353
7	.....	8,080	5,530	2,540	960	567	562	382	280
8	.....	7,760	5,250	2,470	925	587	460	364	359
9	.....	7,450	4,870	2,460	932	552	449	343	373
10	.....	7,170	4,620	2,380	932	460	449	433	391
11	.....	6,810	4,290	2,300	925	608	439	433	414
12	.....	6,530	4,230	2,180	918	508	441	439	340
13	.....	6,090	4,080	2,200	856	497	420	410	395
14	.....	5,590	3,920	2,170	806	515	433	382	391
15	.....	5,420	3,640	2,080	790	492	439	382	356
16	6,500	5,360	3,640	2,070	813	474	439	400	387
17	9,000	5,250	3,660	1,920	758	474	449	373	387
18	12,500	5,060	3,610	1,840	752	474	504	439	373
19	16,100	5,020	3,580	1,760	764	433	400	364	387
20	17,200	5,420	3,510	1,690	733	382	382	391	400
21	18,200	6,480	3,420	1,630	727	410	364	364	400
22	18,500	7,840	3,360	1,560	721	410,	382	425	395
23	18,400	9,690	3,410	1,440	703	410	364	453	387
24	18,100	10,500	3,370	1,360	806	410	497	460	391
25	18,400	10,700	3,180	1,340	840	400	354	439	460
26	16,000	10,800	3,100	1,310	843	400	460	470	470
27	14,500	10,800	2,980	1,230	817	391	406	492	449
28	12,600	10,400	2,880	1,230	784	373	382	445	445
29	10,500	9,730	2,820	1,190	777	373	406	439	429
30	9,260	9,140	2,750	1,170	752	373	391	420	425
31	8,730	.....	2,770	.....	727	400	.....	410	.....

NOTE.—Daily discharge computed from a well-defined rating curve, except from Mar. 16 to 27, which was estimated from the gage heights and a measurement.

Monthly discharge of Red River at Grand Forks, N. Dak., for 1910.

[Drainage area, 25,000 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	1,520	0.061	0.07	93,500	C.
February	.....	.....	1,300	.052	.05	72,200	C.
March	18,500	.....	8,420	.336	.39	518,000	C.
April	10,800	5,020	7,840	.314	.35	467,000	A.
May	8,440	2,750	4,340	.174	.20	267,000	A.
June	2,560	1,170	1,950	.078	.09	116,000	A.
July	1,140	703	860	.034	.04	52,900	A.
August	691	373	490	.020	.02	30,100	A.
September	562	354	426	.017	.02	25,300	A.
October	492	343	413	.017	.02	25,400	A.
November	470	280	395	.016	.02	23,500	B.
December	.....	.....	310	.012	.01	19,100	B.
The year	.....	.....	.....	.094	1.28	1,710,000	

NOTE.—Mean discharge for January, February, and December estimated from discharge measurements, gage heights, and notes regarding ice. Mean discharge, Mar. 1 to 15, estimated, 2,430 second-feet.

PELICAN RIVER NEAR FERGUS FALLS, MINN.

Pelican River rises in Rice Lake near Richwood, Becker County, and flows southward through a chain of lakes, the chief of which are Floyd, Little Floyd, Elsa (elevation, 1,345 feet), Detroit (1,335 feet), Sallie, Melissa (1,330 feet), Pelican (1,320 feet), Lizzie (1,315 feet), and Lida lakes.

The gaging station, which was established June 19, 1909, in connection with the general investigation of the water resources of Minnesota, is located 6 miles northwest of Fergus Falls, in sec. 18 of that township, at a private bridge, from which discharge measurements are made.

Pelican River enters Red River about 5 miles below the gaging station, and as the range of stage in Red River is small, there is no danger of backwater. The nearest dam is at Elizabeth, 6 or 8 miles above the station, and the intermittent operation of the mill at that point causes a slight daily fluctuation in the gage heights. The staff gage at the bridge is read twice each day and the mean of these readings is taken as the mean for the day. It is located at the measuring section.

From the middle of November to the 1st of April, when the river is ice-bound, gage readings are taken through a hole in the ice.

With the exception of the daily fluctuation, due to the mill at Elizabeth, conditions of flow are excellent, and therefore the records should be considered good.

Discharge measurements of Pelican River near Fergus Falls, Minn., 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 12	E. F. Chandler	29	53.0	6.26	126
Aug. 4	....do	29	48.1	5.99	74.6
Sept. 3	....do	29	66.1	6.54	193
Oct. 4	....do	29	68.5	6.56	195
Dec. 12	....do	29	63.0	[a] 7.40	128
1910.					
Feb. 20	E. F. Chandler	28	46.7	[b] 8.55	73.4
July 16	Robert Follansbee	26	37.2	5.78	35.8
Aug. 23[c]	....do	15	7.2	5.44	5.5
Dec. 23	C. R. Adams	.....	.....	[d] 5.8	[e] 1.0

[a] Gage height to water surface; thickness of ice, 1.90 feet.
[b] Gage height to water surface; thickness of ice, 2.50 feet.
[c] Wading section.
[d] Gage height to water surface; thickness of ice about 2 feet.
[e] Discharge estimated.

Daily gage height, in feet, of Pelican River near Fergus Falls, Minn., for 1910.

[Henry W. Luther, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	6.42	6.51	6.11	5.82	5.50	5.36	5.39	5.52	.....
2	.....	.....	8.70	6.46	6.49	6.11	5.81	5.56	5.45	5.40	5.68	5.88
3	.....	8.35	.....	6.49	6.50	6.14	5.70	5.50	5.39	5.58	5.70	.....
4	.....	.....	.....	6.51	6.49	6.11	5.48	5.51	5.36	5.56	5.78	.....
5	.....	.....	9.45	6.59	6.46	6.14	5.46	5.49	5.36	5.61	5.82	.....
6	7.85	.....	.....	6.50	6.45	6.19	5.80	5.46	5.35	5.60	5.55	.....
7	.....	.....	.....	6.49	6.41	6.14	5.50	5.44	5.35	5.59	5.45	.....
8	.....	.....	.....	6.44	6.44	6.14	5.46	5.42	5.36	5.51	5.44	.....
9	.....	.....	9.50	6.49	6.41	6.18	5.54	5.41	5.35	5.46	5.45	6.00
10	.....	8.55	.....	6.51	6.42	6.11	5.52	5.42	5.36	5.54	5.46	.....
11	.....	.....	.....	6.39	6.41	6.09	5.80	5.41	5.34	5.61	5.45	.....
12	.....	.....	.....	6.49	6.39	6.06	5.54	5.42	5.35	5.60	5.46	.....
13	7.85	.....	.....	6.46	6.40	6.04	5.60	5.45	5.41	5.55	5.48	6.15
14	.....	.....	.....	6.50	6.34	6.00	5.48	5.44	5.55	5.45	5.50	.....
15	.....	.....	.....	6.46	6.45	6.04	5.58	5.46	5.41	5.41	5.46	.....
16	.....	.....	8.50	6.60	6.42	5.75	5.48	5.48	5.54	5.31	5.51	6.50
17	.....	.....	.....	6.64	6.38	6.00	5.41	5.45	5.52	5.32	5.50	.....
18	.....	.....	.....	6.61	6.42	5.96	5.88	5.48	5.46	5.38	5.49	.....
19	.....	.....	.....	6.61	6.40	5.78	5.45	5.46	5.40	5.39	5.54	.....
20	.....	8.55	6.54	6.61	6.34	5.76	5.46	5.45	5.34	5.32	.....	5.80
21	8.00	.....	6.50	6.70	6.31	5.90	5.49	5.44	5.36	5.29	.....	.....
22	.....	9.00	6.51	6.69	6.32	5.92	5.51	5.41	5.44	5.31	5.52	.....
23	.....	8.65	6.54	6.70	6.28	5.86	5.52	5.70	5.40	5.35	.....	5.80
24	.....	.....	6.51	6.64	6.32	5.88	5.45	5.45	5.44	5.34	.....	.....
25	.....	.....	6.49	6.51	6.31	5.90	5.49	5.40	5.41	5.35	5.50	.....
26	8.35	.....	6.49	6.49	6.31	5.89	5.51	5.68	5.40	5.35	.....	.....
27	.....	.....	6.46	6.48	6.24	5.82	5.52	5.40	5.40	5.36	.....	.....
28	.....	.....	6.45	6.55	6.21	5.81	5.52	5.40	5.40	5.34	.....	.....
29	.....	.....	6.46	6.44	6.20	5.74	5.80	5.39	5.36	5.34	.....	.....
30	.....	.....	6.48	6.49	6.16	5.71	5.55	5.41	5.39	5.36	5.60	5.70
31	.....	.....	6.49	.....	6.14	.....	5.49	5.41	.....	5.41	.....	.....

NOTE.—Ice present from Jan. 1 to Mar. 19 and from Nov. 20 to Dec. 31.

Daily discharge, in second-feet, of Pelican River near Fergus Falls, Minn., for 1909–10.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1909.							1909.						
1	.....	111	89	170	190	144	16	.....	75	166	200	166	150
2	.....	107	103	178	195	154	17	.....	82	154	205	185	150
3	.....	107	84	190	185	154	18	.....	77	151	180	158	140
4	.....	93	73	180	180	151	19	170	77	144	192	142	140
5	.....	93	75	182	185	151	20	170	36	144	185	156	140
6	.....	56	84	190	180	144	21	144	175	135	200	168	140
7	.....	77	138	190	185	151	22	147	154	138	200	158	130
8	.....	82	147	180	182	151	23	142	144	168	190	168	130
9	.....	66	144	182	200	151	24	129	133	190	195	180	130
10	.....	75	135	180	226	156	25	208	113	182	192	168	130
11	.....	93	154	190	168	151	26	138	101	195	200	168	130
12	.....	111	182	182	180	147	27	71	91	182	200	166	120
13	.....	120	218	180	168	151	28	73	93	180	205	147	120
14	.....	91	218	170	170	150	29	109	91	180	200	142	120
15	.....	80	185	185	168	150	30	113	84	178	192	158	120
							31	.....	89	170	.....	168	.....

NOTE.—Discharge computed from a well-defined rating curve, except from Nov. 14 to 30, for which period the discharge is estimated.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910.											
1	.....	.....	161	182	93	45	11	3.4	4.6	13	.....
2	.....	.....	170	178	93	43	16	8.0	5	28	.....
3	.....	.....	178	180	99	30	11	4.6	18	30	.....
4	.....	.....	182	178	93	9.8	12	3.4	16	40	.....
5	.....	.....	202	170	99	8.6	10	3.4	21	45	.....
6	.....	.....	180	168	109	42	8.6	3.0	20	16	.....
7	.....	.....	178	158	99	11	7.4	3.0	19	8.0	.....
8	.....	.....	166	166	99	8.6	6.2	3.4	12	7.4	.....
9	.....	.....	178	158	107	15	5.6	3.0	8.6	8.0	.....
10	.....	.....	182	161	93	13	6.2	3.4	15	8.6	.....
11	.....	.....	154	158	89	42	5.6	2.6	21	8.0	.....
12	.....	.....	178	154	84	15	6.2	3.0	20	8.6	.....
13	.....	.....	170	156	80	20	8.0	5.6	15	9.8	.....
14	.....	.....	180	142	73	9.8	7.4	16	8	11	.....
15	.....	.....	170	168	80	18	8.6	5.6	5.6	8.0	.....
16	.....	.....	205	161	36	9.8	9.8	15	1.4	12	.....
17	.....	.....	215	151	73	5.6	8.0	13	1.8	11	.....
18	.....	.....	208	161	66	53	9.8	8.6	4.2	10	.....
19	.....	.....	208	156	40	8.0	8.6	5	4.6	15	.....
20	[a] 73	190	208	142	37	8.6	8.0	2.6	1.8	10	.....
21	.....	180	231	135	56	10	7.4	3.4	.9	10	.....
22	.....	182	228	138	59	12	5.6	7.4	1.4	8.0	.....
23	.....	190	231	129	50	13	30	5	3	8.0	[a] 1.0
24	.....	182	215	138	53	8.0	8.0	7.4	2.6	8.0	.....
25	.....	178	182	135	56	10	5.0	5.6	3	8.0	.....
26	.....	178	178	135	55	12	28	5	3	7.0	.....
27	.....	170	175	120	45	13	5.0	5	3.4	7.0	.....
28	.....	168	192	113	43	13	5.0	5	2.6	6.0	.....
29	.....	170	166	111	35	42	4.6	3.4	2.6	6.0	.....
30	.....	175	178	103	31	16	5.6	4.6	3.4	5.0	.....
31	.....	178	.....	99	.....	10	5.6	.....	5.6	.....	.....

[a] Discharge measurement.

NOTE.—Discharge computed from a well-defined rating curve, except from Nov. 20 to 30, for which period it is estimated.

Monthly discharge of Pelican River near Fergus Falls, Minn., for 1909–10.

(Drainage area, 433 square miles.)

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
June 19–30	208	71	134	0.309	0.14	A.
July	175	36	96	.222	.26	A.
August	218	73	151	.349	.40	A.
September	205	170	189	.436	.49	A.
October	226	142	173	.400	.46	A.
November	156	120	142	.328	.37	B.
December	.....	.....	125	.289	.33	C.
1910.						
January	.....	.....	125	.289	.33	C.
February	.....	.....	80	.185	.19	C.
March	.....	.....	180	.416	.48	C.
April	231	154	188	.434	.48	A.
May	182	99	149	.344	.40	A.
June	109	31	70.8	.164	.18	A.
July	53	5.6	18.5	.043	.05	A.
August	50	4.6	9.15	.021	.02	B.
September	16	2.6	5.58	.013	.01	B.
October	21	.8	8.06	.016	.02	B.
November	45	.....	12.7	.029	.03	D.
December	.....	.....	3.00	.0069	.01	D.
The year	231	.....	70.6	.163	2.20	

NOTE.—Mean discharge for December, 1909, and for January, February, and December, 1910, estimated. Mean discharge, Mar. 1 to 19, estimated at 181 second-feet.

WILD RICE RIVER.

GENERAL FEATURES OF AREA DRAINED.

Wild Rice River, next to Red Lake River the most important tributary of Red River, rises in Upper Rice Lake (at an elevation of 1,500 feet above sea level) in T. 145 N., R. 37 W., in the southern part of Clearwater County. It flows southwestward into Lower Rice Lake, which has an area of about 4 square miles, and thence in a general westerly course to its junction with Red River (at an elevation of about 870 feet), near Hendrum post office in Norman County. Its chief tributaries are Simon Lake outlet, Twin Lake outlet, White Earth and Marsh rivers, and the South Branch. During periods of high water Wild Rice River overflows to Marsh River, which is a slough near Ada and has no connection with the Wild Rice at any other time.

The following drainage areas have been measured in the basin:

Drainage areas on Wild Rice River.

	Square miles.
Above Lower Rice Lake outlet	128
Above Faith	567
Above sec. 20, T. 144 N., R. 43 W	752
Above Twin Valley	805
Above sec. 18, T. 144 N., R. 44 W	908
Above mouth	1,440

For the first 2 miles below Lower Rice Lake the river is an arm of the lake controlled by a logging dam which stores water on the lake to a depth of 8 feet or more. Below the dam the slope becomes steeper, and between the mouth of White Earth River and a point 10 miles below Heiberg the average is 4.8 feet per mile. From this point the slope gradually decreases until it nearly disappears below range line 46-47. Notwithstanding this comparatively steep slope the river is in places extremely tortuous. Between Mahnomen and Faith, for example, 7 miles, the distance along the river is 20 miles.

Above Beaulieu the area is rolling and there is no well-defined bluff line, but below that point the ground becomes more level and well-defined bluffs appear. From White Earth River to Heiberg the Wild Rice flows through a valley having an average width of one-fourth mile and lying 20 to 30 feet below the general surface level. Below Heiberg the valley is much narrower. In the upper portion of the basin the surface is somewhat undulating, but along the lower course it is in general flat. Elevations in the basin range from 870 to 1,550 feet above sea level.

With scarcely an exception the valley lands, although not subject to overflow except during unusual floods, are not under cultivation but are heavily timbered. In the prairie section west of Beaulieu much of the land is under cultivation. East of Beaulieu the area is largely covered with brush interspersed with tracts of prairie which constitute possibly a third of this part of the basin. The brush and prairie prevail to a point within a few miles of Lower Rice Lake, and the rest of the basin is heavily covered with pine.

The geology of the basin is very similar to that of the Red Lake basin, the surface formation consisting of chiefly blue till overlain in its lower portion by lacustrine clays and underlain by Cretaceous rocks. The area contains about 50 lakes, all located in its upper third, the lake surface making 5 to 10 per cent of that part of the basin. Many of these lakes are small and have no visible outlet.

The mean annual rainfall ranges from 25 inches in the upper area to 21 inches at the mouth of the river. Of this amount about 2 inches fall as snow, which remains during the winter. From November to April the river flows under ice 2 feet thick. As there are no winter thaws, the winter flow is derived from the lakes and from ground water and is very uniform, decreasing gradually till midwinter, when it is usually a minimum.

No good reservoir sites exist in the basin, as the lakes are too far up on the headwaters to have sufficient tributary run-off to make them of value except as log-driving reservoirs. Although the river itself flows between banks 20 to 30 feet high for a considerable part of its course, the fall of the river is so great that the storage capacity is limited. In order to determine this fact, as well as to determine

the availability of Wild Rice River for power development, a survey was made in 1911 by the United States Geological Survey from the mouth of White Earth River near Mahnomen to a point 11 miles below the Heiberg dam. At this point the survey was tied to a drainage survey by the State drainage engineer, extending to a point below Ada. From the data collected on these surveys sheets have been prepared showing the profile of the water surface, a plan of the river, and the contours along the river bank. These sheets have been published separately and may be had on application to the district engineer, United States Geological Survey, Old Capitol Building, St. Paul, Minn. From these surveys the following table of elevations and distances has been compiled:

Elevations and distances on Wild Rice River.

River.	Distance below mouth of White Earth River.	Elevation above sea level.
	Miles.	*Feet.*
White Earth River	0	1,187
Mahnomen, headwater	2	1,184
Mahnomen, tailwater	2	1,180
Section line 11–10	4	1,173
Highway bridge section line 10–9	6	1,164
Section line 16–17	9	1,156
Section line 17–18	14	1,139
Range line 42–43 W	17	1,128
Section line 13–14	20	1,110
Faith	21	1,102
Creek in sec. 22	23	1,090
Section line 21–22	24	1,076
Creek in sec. 21	25	1,072
	28	1,057
Range line 43–44 W	32	1,033
Section line 26–27	36	1,012
Twin Valley	38	1,005
Section line 21–22	40	1,001
Heiberg, headwater	42	991
Heiberg, foot of dam	42	987
Heiberg, tailwater	43	977
Section line 17–18	45	963
Section line 23–24	50	944
Highway bridge, sec. 15	53	933
Section 16–17	56	920
Highway bridge, range line 45–46	60	910
Highway bridge, near secs. 27–28	66	891
Highway bridge	71	874
Section line 25–36	75	871
South Branch Wild Rice River	83	861
Section line 25–36	88	857
Johnson's dam, crest	92	857
Johnson's dam, foot	92	852
Highway bridge, section line 14–15	97	845
Highway bridge section line 8–9	101	841
Township line 143–144	105	839

At present water power is used at Heiberg, where a fall of 15 feet develops 100 horsepower, and at a point near Perley, where about 65 horsepower is developed.

The Wild Rice is used extensively for log driving, and dams have been built at the outlet of Lower Rice Lake and at Twin Lakes.

These dams hold back the flow during the fall and winter months in order to obtain a sufficient supply to drive the logs to Ada during the spring months. Thus the fall and winter discharge of the river is less than the natural run-off, and the spring discharge is increased by the amount of the stored water. Water can be stored on Lower Rice Lake to a depth of 8 feet by the present dam.

WILD RICE RIVER AT TWIN VALLEY, MINN.

This station, which is located at the steel highway bridge at Twin Valley, Minn., was established June 30, 1909, to obtain data for use in determining available water power and in studying means of flood prevention, which are much needed in this valley.

The nearest tributary is at Heiberg, 2 miles below.

A staff gage is located at the bridge from which discharge measurements are made.

There is a dam across the river at Heiberg, but the highest backwater effect is at a point a mile below Twin Valley. At the outlet of Wild Rice Lake is a logging dam used to store the flow through the winter and early spring months for the purpose of driving the logs to Ada. During the winter period, therefore, the flow at Twin Valley is less than normal, and in the spring the flood flow is augmented by the stored water. There is also a dam at Twin Lake outlet which is used in the same way. An exceptionally severe flood in July, 1909, overflowed the lower part of the valley and wrecked the power dam at Faith by cutting around the end of it and greatly increasing the width of the channel. The maximum stage of this flood was 20 feet at Twin Valley and the corresponding discharge 9,200 second-feet.

The river overflows at a stage of 12 feet and covers a width of several hundred feet.

Sufficient measurements have been made to enable computation of the daily flow. The estimate for the flood discharge above 14 feet is based on Kutter's formula in connection with the known area of the cross section, and may be somewhat in error, but it is believed this error will not exceed 10 per cent. The remaining estimates are based on a well-defined rating curve and should be reliable.

Discharge measurements of Wild Rice River at Twin Valley, Minn., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 16	E. F. Chandler	63	169	6.22	345
17	do	63	188	6.55	416
July 14	do	54	69.9	4.81	61.1
14[a]	do	65	60.1	4.81	55.9
Dec. 18	Gorie Monley	55	36.0	[b]5.00	20.8

[a] Wading measurement.
[b] Gage height to water surface; thickness of ice approximately 0.80 feet.

Daily gage height, in feet, of Wild Rice River at Twin Valley, Minn., for 1910.

[Axel Johnson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.70	8.48	5.90	5.00	4.60	4.40	4.60	4.55	.....
2	.....	5.60	8.65	5.90	5.00	4.60	4.40	4.50	4.55	.....
3	.....	5.50	8.38	5.85	4.90	4.60	4.45	4.50	4.55	.....
4	.....	5.50	7.90	5.90	4.80	4.60	4.45	4.50	4.55	.....
5	.....	5.45	7.50	5.90	4.80	4.55	4.45	4.50	4.55	.....
6	.....	5.55	7.42	5.80	4.80	4.55	4.45	4.50	4.55	.....
7	.....	5.45	7.50	6.00	4.80	4.55	4.45	4.50	.....	.....
8	.....	5.40	7.40	6.70	4.80	4.55	4.45	4.50	.....	.....
9	.....	5.30	7.45	6.90	4.80	4.55	4.45	4.50	.....	.....
10	.....	5.20	7.25	6.50	4.80	4.50	4.45	4.50	.....	.....
11	.....	5.10	7.05	6.45	4.80	4.50	4.50	4.45	.....	.....
12	.....	5.00	6.95	6.75	4.80	4.45	4.50	4.45	.....	4.4
13	.....	4.90	6.80	6.55	4.80	4.40	4.50	4.45	.....	.....
14	.....	4.90	6.68	6.65	4.80	4.40	4.50	4.45	.....	.....
15	.....	4.95	6.60	6.45	4.80	4.40	4.50	4.45	.....	.....
16	.....	5.22	6.95	6.55	4.80	4.40	4.45	4.45	.....	.....
17	.....	6.60	7.20	6.00	4.70	4.40	4.45	4.45	.....	.....
18	.....	6.80	6.57	5.50	4.70	4.35	4.45	4.50	.....	5.0
19	.....	7.20	6.40	5.50	4.65	4.35	4.45	4.50	.....	.....
20	.....	7.65	6.55	5.60	4.60	4.40	4.45	4.55	.....	.....
21	.....	7.78	6.55	5.45	4.60	4.40	4.45	4.55	.....	.....
22	.....	7.82	6.50	5.40	4.60	4.40	4.45	4.55	.....	.....
23	.....	7.85	6.45	5.40	4.75	4.40	4.45	4.55	.....	.....
24	.....	8.80	6.50	5.30	4.80	4.40	4.45	4.55	.....	.....
25	.....	9.20	6.35	5.30	4.85	4.40	4.45	4.55	.....	.....
26	5.60	9.50	6.30	5.20	4.80	4.40	4.45	4.55	.....	.....
27	5.50	9.10	6.30	5.20	4.70	4.40	4.55	4.55	.....	.....
28	5.50	8.90	6.20	5.20	4.70	4.40	4.55	4.55	5.7	5.4
29	5.55	8.70	6.15	5.05	4.60	4.40	4.60	4.55	.....	.....
30	5.60	8.65	6.10	5.00	4.60	4.40	4.60	4.55	.....	.....
31	5.75	.....	5.80	.....	4.60	4.40	.....	4.55	.....	.....

NOTE.—Ice present from Jan. 1 to Mar. 25, and from Nov. 7 to Dec. 31.

Daily discharge, in second-feet, of Wild Rice River at Twin Valley, Minn., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	228	1,110	272	92	32	17	32	28	.....
2	.....	208	1,180	272	92	32	17	23	28	.....
3	.....	188	1,070	261	75	32	20	23	28	.....
4	.....	188	875	272	59	32	20	23	28	.....
5	.....	178	722	272	59	28	20	23	28	.....
6	.....	198	695	250	59	28	20	23	28	.....
7	.....	178	722	295	59	28	20	23	.....	.....
8	.....	168	688	473	59	28	20	23	.....	.....
9	.....	148	705	530	59	28	20	23	.....	.....
10	.....	129	638	419	59	23	20	23	.....	.....
11	.....	110	575	406	59	23	23	20	.....	.....
12	.....	92	545	487	59	20	23	20	.....	.....
13	.....	75	501	432	59	17	23	20	.....	.....
14	.....	75	467	459	59	17	23	20	.....	.....
15	.....	84	445	406	59	17	23	20	.....	.....
16	.....	133	545	432	59	17	20	20	.....	.....
17	.....	445	622	295	44	17	20	20	.....	.....
18	.....	501	437	188	44	14	20	23	.....	a 21
19	.....	622	445	188	38	14	20	24	.....	.....
20	.....	777	432	208	32	17	20	28	.....	.....
21	.....	827	432	178	32	17	20	28	.....	.....
22	.....	843	419	168	32	17	20	28	.....	.....
23	.....	855	406	168	52	17	20	28	.....	.....
24	.....	1,250	419	148	59	17	26	28	.....	.....
25	.....	1,430	380	148	67	17	20	28	.....	.....
26	208	1,560	367	129	59	17	20	28	.....	.....
27	188	1,380	367	129	44	17	28	28	.....	.....
28	188	1,300	343	129	44	17	28	28	.....	.....
29	198	1,210	331	101	32	17	32	28	.....	.....
30	208	1,180	319	92	32	17	32	28	.....	.....
31	239	.....	250	.....	32	17	.....	28	.....	.....

a Discharge measurement.

NOTE.—Discharge computed from a well-defined rating curve.

Monthly discharge of Wild Rice River at Twin Valley, Minn,, for 1910.

[Drainage area, 805 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy
	Maximum.	Minimum.	Mean.	Per square mile.		
April	1,560	75	552	0.686	0.77	A.
May	1,180	250	563	.699	.81	A.
June	530	92	274	.340	.38	A.
July	92	32	53.8	.067	.08	A.
August	32	14	21.0	.026	.03	B.
September	32	17	21.6	.027	.03	C.
October	32	20	24.5	.030	.03	C.
November	.....	.....	25.0	.031	.03	D.
December	.....	.....	[a] 20.0	.025	.03	D.

[a] Estimated.

NOTE.—Mean discharge, Nov. 7 to 30, estimated at 24.7 second-feet.

DEVILS LAKE NEAR DEVILS LAKE, N. DAK.[1]

Devils Lake, in the north-central part of North Dakota, affords an interesting example of the ratios between rainfall, evaporation, and run-off. This lake has no outlet, its size depending entirely upon the relations between the evaporation from its surface, the rainfall upon it, and inflow from the surrounding country. The total area draining to Devils Lake is theoretically somewhat more than 3,500 square miles. Surveys made about 25 years ago, when the region was first settled, showed the lake to have a length of 35 miles, a width ranging from 1 mile to 15 miles, and an area of approximately 120 square miles; because of its many bays and slender arms, the shore line measured more than 200 miles. The present area of the lake is not precisely known but is estimated as not more than 60 square miles.

Since June 8, 1901, the United States Geological Survey has maintained on Devils Lake a staff gage, which is attached to the piles of the pier at the Chautauqua grounds steamer landing, 6 miles southwest of the city of Devils Lake. This gage is read occasionally by Capt. E. E. Heerman. A standard United States Geological Survey bench-mark post is set in the bank directly behind the gage and about 8 rods distant. The gage zero is 1,416.2 feet above sea level, and the bench mark is 22.90 feet above the gage zero.[2]

[1] For description of Devils Lake and all data available from 1867–1908 see Water-Supply Paper U. S. Geol. Survey No. 245, pp. 51–54.

[2] In the description of the station published in Water-Supply Paper U. S. Geol. Survey No. 66, p. 14, and No. 85, p. 238, the statement of the elevation of the bench mark above mean sea level was in error.

That the lake level is still being lowered is shown by the following gage heights, those at the close of the season being the lowest ever recorded:

Gage heights of Devils Lake, N. Dak., in 1910.

	Feet.		Feet.
June 25	9.67	Aug. 4	8.85
July 2	9.57	Aug. 13	8.75
July 12	9.21	Aug. 22	8.66
July 20	9.02	Sept. 1	8.60
July 27	9.01	Sept. 13	8.80
Aug. 1	8.90		

RED LAKE RIVER.

GENERAL FEATURES OF AREA DRAINED.

Red Lake River, the principal tributary of Red River, drains a large area in Beltrami and Polk counties. It is the outlet of Red Lake, which is the largest lake wholly in Minnesota, its area being 441 square miles. From Red Lake the river flows in a general westerly though very tortuous course until it reaches Red Lake Falls, where it receives the water from Thief River, and turning sharply to the south pursues a southerly and then a westerly course to Red River, joining that stream at Grand Forks. Above the junction it carries a larger volume than Red River.

From the outlet of Red Lake to Thief River Falls the river has very little fall and is bordered by low banks. For a distance of 30 miles below Red Lake the river is bordered by swampy banks, whose elevation is nearly the same as the river. Below Thief River Falls the stream flows through a narrow valley that increases in depth from 20 feet at the upper end to 60 feet at Red Lake Falls. In this portion there are stretches of river that have a heavy fall. From Red Lake Falls to Crookston the valley becomes deeper and has an average width of three-quarters of a mile, except for the first few miles below Red Lake Falls, where the width is one-quarter mile. The fall below Red Lake Falls becomes less. No tributaries enter the river between Red Lake and Thief River, a distance of 71 miles; below Thief River the only important tributaries are Clearwater and Black rivers. The following drainage areas have been measured in the basin:

Drainage areas in Red Lake River basin.

	Square miles.
Red Lake River above Red Lake outlet	1,950
Red Lake River above Thief River	2,420
Red Lake River above Huot (including Black River)	5,070
Red Lake River above Crookston	5,320
Red Lake River above mouth	5,760
Thief River above mouth	1,020
Clearwater River above Lost River	521
Clearwater River above mouth	1,310

The entire basin is very flat and is covered with a sheet of blue till of glacial origin. Overlying the till and separated from it is a layer of clay loam. In the lower part of the basin in the valley of the Red River are lacustrine deposits of clay. The drift is underlain by Cretaceous rocks which form the source of supply of the water in the artesian basin in North and South Dakota.

The lakes in the area are chiefly in the section above Red Lake and in the upper part of the region drained by Clearwater River. In the former section lake surface comprises about 500 square miles, or 25 per cent of the area of 1,950 square miles. Of the 1,310 square miles drained by the Clearwater, not more than 1 per cent is lake surface.

The basin is forested except in the part, chiefly below Crookston, which lies in the Red River valley. North of Red Lake there are extensive areas of muskeg containing chiefly a dense growth of short and stubby spruce. Beside the muskeg there are considerable areas of virgin pine north of the lake. West and south of the lake the basin is within the heavy timber belt where white and Norway pine, spruce, cedar, balsam, and tamarack are found. Although this region has been logged over the growth is dense.

In the middle third of the basin, in Marshall, Pennington, and Red Lake counties, the dense forest is interspersed with open prairie which comprises one-third of this part of the area. Above Red Lake Falls very little of the land is under cultivation, but below that point the cultivated area is larger.

The annual rainfall ranges from 25 inches on Red Lake to 21 inches at the mouth. Of this amount 3½ inches are precipitated as snow, which remains during the winter. From November to April the lakes and rivers are frozen over with ice 2 feet or more in thickness. As there are no winter thaws the winter flow is derived from the lakes and from ground water and is very uniform, decreasing gradually till midwinter when it is at the minimum.

A survey to determine the availability of Red Lake River for power development was made during 1910 from Red Lake to Crookston, and in 1911 a special survey was made of Red Lake, which is by far the best reservoir site in the basin. From the data thus collected sheets have been prepared showing the profile of the water surface, a plan of the river and the contours along the river bank, the shore line of the lake, and the location of the 5-foot contour above and below the lake surface. These maps may be obtained by applying to the district engineer, United States Geological Survey, Old Capitol Building, St. Paul, Minn.

From the river survey the following table of elevations and distances has been compiled:

Elevations and distances along Red Lake River.

Place.	Distance above Crookston.	Elevation above sea level.
	Miles.	*Feet.*
Crookston, tailwater	0	842
Crookston, headwater	0	852
Section line 32–33	6	853
Highway bridge	11	861
Do	14	865
Section line 7–8	18	873
Polk-Red Lake County line	23	883
Huot Bridge	26	887
Section line 26–27	28	893
Section line 25–26	30	904
Range line 44–45 W	32	917
Northern Pacific Railway	37	937
Lower dam, tailwater	38	943
Lower dam, headwater	38	955
Red Lake Falls, highway bridge	39	955
Upper dam, tailwater	42	963
Upper dam, headwater	42	973
Range line 43–44 W	45	981
	47	1,007
	49	1,027
Section line 17–20	56	1,062
St. Hilaire, tailwater	61	1,075
St. Hilaire, headwater	61	1,080
Section line 17–20	67	1,085
Thief River Falls, tailwater	72	1,102
Thief River Falls, headwater	72	1,116
Range line 42–43 W	77	1,118
Section line 10–15	85	1,130
Range line 41–42 W	90	1,136
Section line 22–23	99	1,145
Township line 152–153 N	110	1,154
Western boundary Red Lake Indian Reservation	124	1,165
Red Lake	143	1,175

The following table of approximate distances and elevations has been compiled chiefly from the reports of the Minnesota Geological Survey:

Elevations and distances along Clearwater River.

Place.	Distance above mouth.	Elevation above sea level.
	Miles.	*Feet.*
Red Lake River	0	955
Sec. 26, T. 151 N., R. 44 W	3	1,000
Sec. 6, T. 150 N., R. 42 W., The Forks	16	1,050
Sec. 32, T. 152 N., R. 41 W	28	1,100
Sec. 2, T. 151 N., R. 39 W	49	1,150
Sec. 27, T. 150 N., R. 37 W	69	1,200
Sec. 6, T. 149 N., R. 36 W	73	1,250
Sec. 11, T. 149 N., R. 36 W	80	1,300
Sec. 29, T. 149 N., R. 35 W	86	1,350
Bagley	112	1,400
Ebro	120	1,440

Water power is developed at the following points:

Developed water power on Red Lake and Clearwater Rivers.

Place.	Stream.	Fall utilized.	Average horsepower.
		Feet.	
Thief River Falls	Red Lake River	12	225
Red Lake Falls	do	12	125
Do	do	14	125
Crookston	do	10	850
Terrebonne	Clearwater River	10	80

The upper part of the basin contains large areas of swamp land. In the part drained by Thief River drainage work is being actively carried on. Three systems, draining 470,000 acres lying west of Thief River, have their outlets in that stream in Tps. 155 and 156. One of the outlets passes through Mud Lake, which has been drained. The channel of Thief River has been enlarged and straightened for a distance of 21 miles, beginning a few miles above the gaging station and extending upstream. The average width is 50 feet and the depth 12 feet.

Red Lake River is used extensively for log driving, the logs being brought from Red Lake to Crookston. These logs frequently jam on the rapids and cause backwater. There are no logging dams to control the flow.

Until 1910 the upper river was navigable and small steamers ran from Red Lake to Thief River Falls. The low water of 1910 and 1911 made navigation impossible, both on account of shallow water and frequency of log jams.

An examination of Red Lake and Red Lake River was made by the United States Engineer Corps and the results published in House Document No. 127, Fifty-second Congress, first session, and House Document No. 539, Fifty-eighth Congress, second session.

An investigation of the swamp lands tributary to Mud River in the Thief River basin was made by the United States Geological Survey and the results (including a plan for drainage) published in House Document 607, Fifty-ninth Congress, second session. This report contains a topographic map with 10-foot contours.

An examination of the ceded Chippewa lands in Red Lake and Rainy River basins was made by the United States Geological Survey, and the results, including a plan for drainage, were published in House Document 27, Sixty-first Congress, first session. The report contains a list of bench-mark elevations and a topographic map on a scale of 1:125,000.

Records of flow have been maintained in the basin since 1901. During that period the driest year was 1910 and the wettest 1906.

The ratio of flow of these two years was 1 to 1.80. This uniformity is accounted for by the regulating effect of Red Lake and the fact that much of the area was flat and swampy.

RED LAKE RIVER AT THIEF RIVER FALLS, MINN.

This station, which is located one-third mile below the dam at Thief River Falls, was established July 2, 1909, to obtain data for use in connection with the development of water power and the practicability of storage on upper Red Lake River as an aid to navigation and flood prevention.

The nearest tributary, Thief River, enters a mile or more above the station. The drainage area above this point is 3,430 square miles.

The dam which supplies head to the Hansen & Barzen mill and the city-lighting plant is a short distance above the station. The varying loads on the turbines cause a fluctuation in the river below the dam. This fluctuation is reduced by the operation of the lighting plant at night and of the mill, chiefly during the daytime. The gage is read morning and evening and the mean of the two readings is taken as the mean for the day. Logs are floated down Red Lake River and by jamming may cause backwater for a few days or may hold back the normal flow above the gage. The log jams interfered with the records in 1910 to such an extent that no estimates of flow are presented after July 31.

Discharge measurements are made by means of a car and cable located at the gage section.

From the later part of November to the 1st of April the river is frozen over and the gage heights are taken through the ice.

Conditions at this station are not satisfactory, but are typical of the entire upper river, and therefore the records can not be considered better than fair.

Discharge measurements of Red Lake River at Thief River Falls, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 19	Chandler and Nomland	142	426	5.83	972
20	....do	140	414	5.74	886
Sept. 15	E. F. Chandler	139	442	5.96	906
27	J. O. Nomland	144	524	6.55	1,020
1910.					
Feb. 5	J. O. Nomland	127	402	[a] 6.78	690
Mar. 23	....do	142	784	8.37	2,830
25	....do	144	818	8.51	3,010
Apr. 9	....do	140	682	7.80	2,470
25	....do	142	674	7.68	2,320
May 6	....do	141	568	7.02	1,630
July 13	E. F. Chandler	137	329	5.20	543
Dec. 20	Gorie Monley	.....	262	[b] 4.62	136

[a] Gage height to water surface; thickness of ice, 1.05 feet.
[b] Gage height to water surface; thickness of ice, 0.70 foot.

Daily gage height, in feet, of Red Lake River at Thief River Falls, Minn., for 1910.

[Chas. P. Quist, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	.....	.....	6.45	8.20	7.32	6.50	5.08
2	.....	6.80	.....	8.15	7.08	6.60	5.10
3	.....	.....	.....	8.08	7.18	6.85	4.95
4	.....	.....	.....	8.15	7.05	6.54	4.95
5	.....	6.80	6.60	8.14	6.95	6.04	5.05
6	.....	.....	.....	8.10	6.95	6.02	5.12
7	.....	.....	.....	7.98	6.80	6.15	5.05
8	.....	6.70	6.70	7.88	6.54	6.05	4.95
9	.....	.....	.....	7.80	6.68	5.95	4.80
10	.....	.....	.....	7.75	6.62	5.86	4.82
11	.....	.....	.....	7.55	6.60	5.78	4.78
12	.....	.....	.....	7.25	6.55	5.78	4.78
13	.....	.....	.....	6.92	6.50	5.85	4.84
14	.....	.....	.....	7.05	6.65	5.65	4.84
15	6.60	.....	7.60	6.92	6.90	5.70	4.80
16	.....	.....	.....	7.20	7.10	5.68	4.64
17	.....	.....	.....	7.38	7.25	5.65	4.75
18	.....	.....	.....	7.55	6.45	5.50	4.75
19	6.70	6.45	7.65	7.96	6.39	5.50	4.75
20	.....	.....	.....	8.35	6.42	5.36	4.92
21	.....	.....	.....	8.25	6.39	5.30	4.95
22	6.70	.....	7.50	8.05	6.20	5.30	4.80
23	.....	.....	.....	7.74	6.29	5.35	4.75
24	6.60	6.45	8.70	7.66	6.16	5.60	4.81
25	.....	.....	8.60	7.68	6.18	5.36	4.82
26	.....	6.40	.....	7.52	6.14	5.35	4.80
27	.....	.....	.....	7.42	6.16	5.38	5.05
28	.....	.....	.....	7.41	6.35	5.25	4.92
29	6.70	.....	.....	7.45	6.10	5.05	4.92
30	.....	.....	.....	7.45	6.12	5.25	4.92
31	.....	.....	.....	.....	6.25	.....	5.05

NOTE.—The river was frozen across from Jan. 1 to about the middle of March. The river was clear of ice on Mar. 23. Gage heights for May 16 and 17, and June 1 to 4 were affected by log jams. After July 31 the readings are not an index of the flow, because of backwater from a large log jam down stream.

Daily discharge, in second-feet, of Red Lake River at Thief River Falls, Minn., for 1909–10.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1909.						1909.					
1	850	735	972	740	1,050	16	1,980	990	872	889	[a] 90
2	872	757	960	725	1,040	17	1,820	906	872	930	635
3	710	779	960	695	1,030	18	1,660	872	930	936	790
4	685	779	930	762	1,050	19	2,970	801	900	966	735
5	834	801	872	779	1,090	20	3,500	746	912	954	762
6	1,090	762	845	746	1,130	21	2,920	735	1,050	1,080	750
7	1,000	779	817	762	1,110	22	1,780	762	1,140	1,140	750
8	1,090	900	735	735	1,180	23	1,210	735	1,210	1,170	750
9	1,160	936	665	735	1,130	24	1,090	1,020	1,320	1,110	725
10	1,080	948	710	640	1,080	25	1,010	1,280	1,320	1,170	725
11	1,070	1,110	675	834	1,160	26	990	1,350	1,280	1,180	725
12	1,700	1,120	710	1,020	1,130	27	1,070	1,240	1,280	1,070	725
13	1,800	1,110	817	984	1,020	28	900	1,140	1,280	1,020	725
14	1,900	1,050	845	924	[a] 245	29	845	1,070	1,270	1,030	700
15	1,940	936	845	900	[a] 100	30	695	1,140	1,010	1,040	700
						31	710	1,090	.....	1,050	.....

[a] Water held back by ice and log jams and discharge estimated.

Daily discharge, in second-feet, of Red Lake River at Thief River Falls, Minn., for 1909–10—Continued.

Day.	Feb.	Apr.	May.	June.	July.	Day.	Feb.	Apr.	May.	June.	July.
1910.						1910.					
1		2,720	1,920	a 1,080	486	16		1,820	a 1,470	779	309
2		2,670	1,720	a 1,060	495	17		1,970	a 1,360	762	350
3		2,610	1,800	a 1,040	430	18		2,120	1,240	685	350
4		2,670	1,700	a 1,010	430	19		2,490	1,200	685	350
5	b 690	2,660	1,620	984	472	20		2,870	1,220	615	418
6		2,620	1,620	972	504	21		2,270	1,200	585	430
7		2,510	1,500	1,050	472	22		2,370	1,080	585	370
8		2,420	1,310	990	430	23		2,290	1,140	610	350
9		2,340	1,410	930	370	24		2,210	1,060	735	374
10		2,290	1,360	878	378	25		2,320	1,070	615	378
11		2,120	1,350	834	362	26		2,090	1,040	610	370
12		1,860	1,320	834	362	27		2,000	1,060	625	472
13		1,590	1,280	872	386	28		1,990	1,180	562	418
14		1,700	1,390	762	386	29		2,030	1,020	472	418
15		1,590	1,580	790	370	30		2,030	1,030	562	418
						31			1,110		472

a Water held back by ice and log jams and discharge estimated. b Discharge measurement.

NOTE.—Discharges based on a rating curve that is not well defined.

Monthly discharge of Red Lake River at Thief River Falls, Minn., for 1909–10.

[Drainage area, 3,430 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
July	3,500	685	1,380	0.402	0.46	C.
August	1,350	735	948	.276	.32	C.
September	1,320	665	967	.282	.31	C.
October	1,180	640	926	.270	.31	C.
November	1,180		828	.241	.27	C.
December			a 700	.204	.24	C.
1910.						
January			a 530	.155	.18	C.
February			a 530	.155	.16	C.
March			a 2,200	.641	.74	D.
April	2,870	1,590	2,260	.659	.74	C.
May	1,920	1,020	1,330	.388	.45	C.
June	1,080	472	786	.229	.26	C.
July	504	309	406	.118	.14	C.

a Estimated.

RED LAKE RIVER AT CROOKSTON, MINN.

This station, which is located a short distance below the dam in Crookston, at the new highway bridge, was established May 19, 1901, to obtain data necessary in developing water power on Red Lake River, and also in planning relief for the serious floods in the lower Red River valley.

No tributaries enter within several miles of Crookston. Less than a quarter of a mile above this station are the dam and power house of the Crookston Waterworks, Power & Light Co. As the power plant operated almost continuously, though with varying load, the

gage heights below the dam fluctuate less than they would if the plant were shut down during a portion of the time with the water below the crest of the dam. The gage is read twice a day or oftener to determine the daily mean stage.

Until July 1, 1909, the chain gage and auxiliary staff gages were located at the old "Sampson's Addition" bridge, but on that date a new chain gage was installed on the new steel bridge, 20 rods below, and set to read the same as the original gage, whose datum has remained constant since the station was established. Discharge measurements are now made from this bridge.

The river channel at the old gaging section was wholly or partly open during the winter, owing to the presence of the dam, but at the the present section the river freezes entirely across from December to March, and discharge measurements are made through the ice to determine the approximate winter flow.

The daily fluctuation of the water surface may possibly cause a slight error in the daily mean gage height, but otherwise the records of this station should be considered good.

The daily discharge and monthly estimates for all years prior to 1910, inclusive, have been published in "Report of water-resources investigation of Minnesota during 1909–10," by the State drainage commission, St. Paul, Minn.

Discharge measurements of Red Lake River at Crookston, Minn., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 8	J. O. Nomland	149	394	[a] 6.57	767
Mar. 1	do	147	342	[b] 6.30	646
Apr. 6	do	184	1,580	10.04	5,070
July 13	E. F. Chandler	153	356	3.76	461
Nov. 7	do	150	258	3.18	275
7[c]	do	146	148	2.49	56.2
7[c]	do	145	146	2.42	67.4
Dec. 21	Gorie Monley	141	477	[d] 3.76	185

[a] Gage height to water surface; thickness of ice, 2.10 feet. Stage rose .48 foot during measurement.
[b] Gage height to water surface; thickness of ice, 2.60 feet.
[c] Low water due to closure of turbines in the power house above gage.
[d] Gage height to water surface; thickness of ice, 1.10 feet.

Daily gage height, in feet, of Red Lake River at Crookston, Minn., for 1910.

[J. E. Carroll, observer.]

Day.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		6.30	10.90	8.28	5.25	4.25	4.65	2.93	3.63	2.90	3.35
2			10.80	8.03	5.25	4.15	3.68	3.16	3.00	3.00	3.30
3			10.60	7.88	5.27	3.95	3.53	3.27	3.35	2.40	3.33
4			10.40	7.55	5.28	3.85	3.52	2.90	3.40	2.75	3.25
5			10.30	7.55	4.80	4.12	3.50	3.90	3.35	2.70	3.23
6			10.00	7.50	5.30	4.08	3.50	3.85	3.30	2.50	3.05
7			10.00	7.30	5.40	4.05		4.00	3.40	2.80	3.50
8	6.60		9.50	6.85	5.65	4.17	3.20	3.80	3.40	2.80	3.30
9			9.30	6.70	5.40	4.10	3.75	3.40	3.40	3.15	3.75
10			9.10	6.50	5.40	3.75	3.45	3.30	3.63	3.05	3.75

Daily gage height, in feet, of Red Lake River at Crookston, Minn., for 1910—Continued.

Day.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	.....	8.90	6.62	5.20	3.95	3.58	3.20	3.38	3.10	3.45
12	.....	.....	8.50	6.30	6.00	3.80	3.48	3.40	3.23	3.10	3.45
13	.....	8.90	8.00	6.25	5.25	3.62	3.45	3.30	3.17	3.15	3.70
14	.....	10.20	7.80	6.20	5.27	3.85	3.35	3.35	3.30	3.00	3.85
15	.....	10.85	7.80	6.10	4.93	4.05	3.42	3.35	2.90	2.90	3.80
16	.....	11.10	7.80	6.17	5.00	4.05	3.42	3.30	2.90	3.10	3.70
17	.....	11.40	8.10	6.15	4.95	3.88	3.25	3.30	2.90	3.30	3.60
18	6.80	12.15	8.15	6.15	4.80	3.90	2.80	3.20	2.90	3.20	3.60
19	.....	13.25	8.60	6.00	4.70	3.70	3.30	3.25	3.13	3.10	3.60
20	.....	13.80	9.95	6.00	4.80	3.70	3.25	3.30	3.30	2.90	3.45
21	.....	11.60	10.90	6.05	4.62	3.55	3.40	3.30	3.40	3.00	3.55
22	.....	10.25	11.10	6.05	4.50	3.67	3.25	2.97	3.40	3.10	3.25
23	.....	10.60	10.55	6.02	4.32	4.20	3.31	3.40	3.40	3.05	3.45
24	.....	10.75	9.60	5.95	4.48	4.25	3.32	3.62	3.37	3.15	3.40
25	.....	10.85	9.40	6.01	4.60	4.10	3.30	3.45	3.30	3.00	3.65
26	6.60	11.00	9.15	5.80	4.00	4.10	3.42	3.35	2.95	3.05	3.65
27	.....	10.80	9.00	5.80	4.65	4.07	3.20	3.17	3.37	3.00	3.55
28	.....	9.75	8.70	5.70	4.45	4.03	3.40	3.40	2.95	2.98	3.40
29	.....	9.50	8.60	5.75	4.50	4.00	3.20	3.40	3.08	2.90	3.40
30	.....	10.25	8.50	5.70	4.35	4.00	3.40	3.37	3.10	2.95	3.40
31	.....	10.60	.....	5.38	.....	3.75	3.18	.....	3.07	.....	3.50

NOTE.—Ice present from Jan. 1 to Mar. 12 and from Dec. 3 to 31.

Daily discharge, in second-feet, of Red Lake River at Crookston, Minn., for 1910.

Day.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	[a]646	5,380	3,280	1,230	680	898	204	416	196	325
2	.....	650	5,300	3,080	1,230	630	433	269	224	224	310
3	.....	650	5,130	2,970	1,240	538	382	301	325	72	319
4	.....	650	4,970	2,720	1,250	495	379	196	340	157	.....
5	.....	700	4,890	2,720	980	615	372	515	325	144	.....
6	.....	700	4,640	2,680	1,260	596	372	495	310	96	.....
7	.....	700	4,640	2,540	1,320	582	326	560	340	170	.....
8	[a]767	700	4,240	2,220	1,460	640	280	475	340	170	.....
9	.....	800	4,080	2,110	1,320	605	458	340	340	266	.....
10	.....	900	3,920	1,980	1,320	458	356	310	416	238	.....
11	.....	1,000	3,760	2,060	1,200	538	398	280	334	252	.....
12	.....	1,500	3,450	1,850	1,670	475	366	340	289	252	.....
13	.....	3,760	3,060	1,820	1,230	412	356	310	272	266	.....
14	.....	4,800	2,910	1,790	1,240	495	325	325	310	224	.....
15	.....	5,340	2,910	1,730	1,050	582	346	325	196	196	.....
16	.....	5,540	2,910	1,770	1,090	582	346	310	196	252	.....
17	.....	5,800	3,140	1,760	1,060	507	295	310	196	310	.....
18	.....	6,430	3,180	1,760	980	515	170	280	196	280	.....
19	.....	7,360	3,530	1,670	925	440	310	295	260	252	.....
20	.....	7,830	4,600	1,670	980	440	295	310	310	196	.....
21	.....	5,960	5,380	1,700	881	388	340	310	340	224	[a]185
22	.....	4,840	5,540	1,700	815	430	295	216	340	252	.....
23	.....	5,130	5,090	1,680	716	655	313	340	340	238	.....
24	.....	5,260	4,320	1,640	804	680	316	412	331	266	.....
25	.....	5,340	4,160	1,680	870	605	310	356	310	224	.....
26	.....	5,460	3,960	1,550	560	605	346	325	210	238	.....
27	.....	5,300	3,840	1,550	898	592	280	272	331	224	.....
28	.....	4,440	3,610	1,490	788	574	340	340	210	218	.....
29	.....	4,240	3,530	1,520	815	560	280	340	246	196	.....
30	.....	4,840	3,450	1,490	732	560	340	331	252	210	.....
31	.....	5,130	.....	1,300	.....	458	274	.....	244	.....	.....

[a] Discharge measurement.

NOTE.—Discharge determined from well defined rating curves, except for Mar. 2 to 12, which were estimated.

Monthly discharge of Red Lake River at Crookston, Minn., for 1910.

[Drainage area, 5,320 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	754	0.142	0.16	C.
February	.....	.....	700	.132	.14	C.
March	7,830	646	3,630	.682	.79	B.
April	5,540	2,910	4,120	.774	.86	A.
May	3,280	1,300	1,980	.372	.43	A.
June	1,670	560	1,060	.199	.22	A.
July	680	388	546	.103	.12	A.
August	898	170	352	.066	.08	A.
September	560	196	333	.063	.07	A.
October	416	196	293	.055	.06	A.
November	310	72	217	.041	.05	A.
December	325	.....	219	.041	.05	D.
The year	7,830	.....	1,180	.222	3.03	

NOTE.—Mean discharge for January and February estimated. Mean discharge, for Dec. 3 to 31, estimated at 209 second-feet.

THIEF RIVER NEAR THIEF RIVER FALLS, MINN.

This station, which is located at the Drybrooke ford, 6 miles north of Thief River Falls, in sec. 3, T. 154 N., R. 43 W., was established July 1, 1909, in connection with the general plan of investigating the water resources of Minnesota and also to determine the practicability of draining swamp lands in the basin.

Thief River, which is the outlet of Thief Lake in the northeastern part of Marshall County, has its ultimate source in Moose River, which rises in the western part of Beltrami County. The entire area drained by Thief River is 1,030 square miles.

The nearest tributary is the outlet of Mud Lake, which enters Thief River in the northeastern part of T. 156 N., R. 42 W.

The nearest dam is at Thief River Falls at the mouth of Thief River. This dam backs up the water in Thief River for several miles, but produces no effect at the gage, owing to rapids below the station.

During 1910 drainage has been carried on extensively in Thief River basin, and the effect will be to modify the regimen of the river. The extremely low flow of 1910 was caused partly by the fact that temporary dams were built on the upper river to hold back the flow for the floating dredges.

Discharge measurements are made by means of a boat and cable a short distance below the staff gage, or by wading at the ford at very low stages.

From the middle of November to the first of April the river is entirely frozen over and readings are taken through the ice.

Discharge measurements of Thief River near Thief River Falls, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 1[a]	E. F. Chandler	136	212	6.21	327
Aug. 2[a]	do	111	248	6.36	381
16	Chandler and Nomland	82	233	6.36	371
19	do	81	220	6.14	288
Sept. 15	E. F. Chandler	81	227	6.25	324
Oct. 1	J. O. Nomland	80	210	6.12	298
1910.					
Feb. 7	J. O. Nomland	75	73.5	[b]6.24	62.3
Mar. 22	do	82	251	6.49	442
Apr. 9	do	90	464	8.82	1,270
25	do	89	387	8.05	998
May 6	do	84	298	7.08	645
July 12	E. F. Chandler	74	117	4.86	53.4
Oct. 6	do			3.35	[c]0.2

[a] Wading measurement.
[b] Gage height of water surface; thickness of ice, 1.70 feet.
[c] Discharge estimated.

Daily gage height, in feet, of Thief River near Thief River Falls, Minn., for 1910.

[H. J. Maland, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1				8.92	7.56	5.88	5.08	5.28	4.36
2				9.06	7.48	5.84	5.04	5.25	4.32
3	6.50	6.30		9.20	7.30	5.85	5.00	5.10	4.38
4				9.20	7.22	5.88	5.00	5.10	4.40
5			5.30	9.20	7.16	5.88	5.30	4.98	4.48
6				9.20	7.08	5.86	5.30	4.82	4.48
7		6.24		9.12	7.01	5.84	5.04	4.80	4.48
8				8.98	6.91	5.82	5.00	4.78	4.44
9				8.78	6.82	5.76	4.95	4.69	4.40
10	6.50			8.68	6.72	5.72	4.78	4.60	4.28
11				8.48	6.62	5.71	4.87	4.60	4.05
12		6.10	6.45	8.35	6.56	5.66	4.87	4.60	3.85
13				8.24	6.51	5.64	4.92	4.60	3.72
14				8.14	6.49	5.60	4.92	4.60	3.68
15				8.12	6.46	5.56	4.91	4.60	3.65
16				8.21	6.46	5.51	4.90	4.65	3.59
17			6.72	8.14	6.32	5.50	4.90	4.65	3.65
18				8.16	6.30	5.46	4.89	4.65	3.62
19	6.48			8.48	6.36	5.42	4.84	4.61	3.60
20		5.80		8.69	6.32	5.39	5.58	4.55	3.55
21			7.98	8.60	6.22	5.36	5.74	4.48	3.55
22			6.54	8.45	6.19	5.34	5.72	4.48	3.55
23			6.90	8.06	6.14	5.44	5.72	4.45	3.55
24			7.00	8.12	6.11	5.42	5.68	4.51	3.50
25			7.10	8.06	6.10	5.30	5.65	4.65	3.50
26	6.40		7.14	7.98	6.09	5.22	5.62	4.68	3.50
27		5.42	7.29	7.88	6.01	5.25	5.60	4.60	3.50
28			7.55	7.72	6.00	5.21	5.56	4.41	3.50
29			8.05	7.65	5.94	5.04	5.51	4.40	3.50
30			8.60	7.62	5.90	5.08	5.48	4.40	3.50
31			8.76		5.90		5.45	4.40	

NOTE.—Ice present from Jan. 1 to Mar. 15.
River below 3.4 feet the entire month of October. Practically no flow during October, November, and December; water held back for dredging.

Daily discharge, in second-feet, of Thief River near Thief River Falls, Minn., for 1909–10.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1909.										
1						327	347	288	288	361
2						249	334	288	288	361
3						219	423	276	314	357
4						187	392	294	320	354
5						146	406	282	340	354
6						122	361	282	354	354
7						112	337	262	371	347
8						103	569	259	381	337
9						97	525	259	381	337
10						97	514	259	381	337
11						97	532	259	374	327
12						221	525	259	357	320
13						228	473	294	354	294
14						209	459	327	354	.....
15						221	427	337	361	.....
16						191	385	320	361	.....
17						166	354	301	368	.....
18						150	327	288	361	.....
19						1,970	304	320	361	.....
20						1,700	282	320	368	.....
21						1,440	259	368	406	.....
22						1,040	307	361	395	.....
23						810	288	351	395	.....
24						736	441	327	395	.....
25						550	495	317	395	.....
26						488	466	307	388	.....
27						430	430	304	374	.....
28						388	388	304	361	.....
29						361	347	291	368	.....
30						347	288	288	368	.....
31						361	282	.....	361	.....
1910.										
1			1,330	814	228	82	109	20	.....	.....
2			1,380	784	219	77	104	18	.....	.....
3			1,440	717	221	72	84	21	.....	.....
4			1,440	687	228	72	84	22	.....	.....
5			1,440	665	228	112	70	27	.....	.....
6			1,440	636	223	112	54	27	.....	.....
7	[a] 62		1,410	610	219	77	52	27	.....	.....
8			1,350	573	214	72	50	24	.....	.....
9			1,280	539	200	67	43	22	.....	.....
10			1,240	502	191	50	36	16	.....	.....
11			1,160	466	189	59	36	7.5	.....	.....
12			1,110	445	179	59	36	3.0	.....	.....
13			1,170	427	174	64	36	1.2	.....	.....
14			1,030	420	166	64	36	.9	.....	.....
15			1,030	409	158	63	36	.8	.....	.....
16			1,060	409	148	62	40	.5	.....	.....
17			1,030	361	146	62	40	.8	.....	.....
18			1,040	354	139	61	40	.6	.....	.....
19			1,160	374	132	56	37	.5	.....	.....
20			1,240	361	126	162	31	.4	.....	.....
21		973	1,210	327	122	196	27	.4	.....	.....
22		437	1,150	317	118	191	27	.4	.....	.....
23		569	1,000	301	135	191	25	.4	.....	.....
24		606	1,030	291	132	183	29	.3	.....	.....
25		643	1,000	288	112	176	40	.3	.....	.....
26		658	973	285	100	170	42	.3	.....	.....
27		713	935	262	104	166	36	.3	.....	.....
28		810	875	259	98	158	23	.3	.....	.....
29		1,000	848	243	77	148	22	.3	.....	.....
30		1,210	837	233	82	142	22	.3	.....	.....
31		1,270	.....	233	.....	137	22	.....	.....	.....

[a] Discharge measurement.

NOTE.—Discharge based on a well-defined rating curve. Practically no flow during October, November, and December, 1910.

Monthly discharge of Thief River near Thief River Falls, Minn., for 1909–10.

[Drainage area, 1,010 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
July	1,970	97	444	0.440	0.51	A.
August	569	282	396	.392	.45	A.
September	368	259	300	.297	.33	A.
October	406	288	363	.359	.41	A.
November	361		290	.287	.32	C.
December			200	.198	.23	D.
1910.						
January			100	.099	.11	C.
February			45	.045	.05	C.
March	1,270		330	.327	.38	B.
April	1,440	837	1,150	1.14	1.27	A.
May	814	233	438	.434	.50	A.
June	228	77	160	.158	.18	A.
July	196	50	108	.107	.12	A.
August	109	22	44.2	.044	.05	A.
September	27	.3	8.12	.0080	.009	A.
October	0	.0	0.00	.000	.00	
November	0	.0	0.00	.000	.00	
December	0	.0	0.00	.000	.00	
The year	1,440	.0	199	.197	2.67	

NOTE.—Mean discharge estimated for December, 1909, January and February, 1910. Mean for Nov. 14 to 30 estimated at 251 second-feet. Mean for March 1 to 20 estimated at 67 second-feet.

CLEARWATER RIVER AT RED LAKE FALLS, MINN.

Clearwater River rises in the western part of Clearwater County, near Ebro (elevation 1,440 feet), and flows northwest and southwest, emptying into Red Lake River (elevation 955 feet) at Red Lake Falls.

The gaging station, which is located 30 rods southeast of the Great Northern Railway station at Red Lake Falls and 1½ miles above the mouth of the Clearwater, was established June 18, 1909, to determine the amount of available power on this stream.

The nearest tributary is 2 miles above Red Lake Falls. The station is at least half a mile above the influence of the Healy dam, which is located a short distance below the mouth of Clearwater River.

The gage is an inclined staff on the right bank. Discharge measurements are made at high stage from a car and cable located at a tag-wire section a short distance below the gage; during medium and low stages wading measurements are made at the tag-wire section.

From the middle of November to the first of April, when the river is frozen over, gage readings are taken through a hole in the ice.

Conditions at this station are excellent, and the records may be considered reliable.

Discharge measurements of Clearwater River at Red Lake Falls, Minn., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 4	J. O. Nomland	151	91.4	[a] 7.52	117
Mar. 23	....do	182	600	9.40	2,190
July 11[b]	E. F. Chandler	78	43.7	5.66	32.4
Dec. 19	Gorie Monley	.....	101	[c] 6.62	50.8

[a] Gage height and water surface; thickness of ice, 1.30 feet.
[b] Wading measurement.
[c] Gage height to water surface; thickness of ice, 1.30 feet.

Daily gage height, in feet, of Clearwater River at Red Lake Falls, Minn., for 1910.

[James Benoit, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	7.35	9.29	8.16	6.60	5.61	5.74	5.70	5.70	.....	.....
2	7.80	.....	.....	9.24	8.10	6.82	5.64	5.68	5.70	5.70	5.92	.....
3	7.82	.....	.....	9.16	8.02	6.89	5.62	5.70	5.70	5.70	.....	.....
4	7.85	7.52	.....	9.09	7.92	6.92	5.64	5.68	5.75	5.70	.....	.....
5	.....	.....	.....	9.02	7.80	6.96	5.64	5.68	5.79	5.70	.....	6.25
6	.....	.....	.....	8.91	7.62	6.96	5.69	5.69	5.90	5.70	.....	.....
7	.....	.....	.....	8.82	7.39	6.96	5.68	5.70	5.85	5.82	5.90	.....
8	.....	.....	.....	8.66	7.29	6.80	5.65	5.70	5.82	5.78	.....	.....
9	.....	.....	7.40	8.52	7.19	6.51	5.62	5.69	5.84	5.78	.....	6.65
10	.....	.....	.....	8.51	7.06	6.54	5.65	5.64	5.79	5.78	5.90	.....
11	7.62	.....	.....	8.44	6.99	6.56	5.59	5.68	5.72	5.78	.....	.....
12	.....	.....	.....	8.34	6.88	6.49	5.54	5.68	5.75	5.79	.....	.....
13	.....	.....	.....	8.28	6.78	6.50	5.59	5.61	5.72	5.80	.....	.....
14	.....	.....	.....	8.12	6.67	6.35	5.60	5.60	5.72	5.85	5.92	.....
15	.....	.....	.....	8.10	6.65	6.21	5.68	5.65	5.76	5.88	.....	.....
16	.....	7.48	.....	8.09	6.68	6.14	5.60	5.68	5.85	5.88	.....	.....
17	.....	.....	.....	8.06	6.62	5.91	5.60	5.68	5.84	5.86	5.95	.....
18	.....	.....	.....	8.18	6.65	6.00	5.62	5.61	5.82	5.84	.....	.....
19	7.32	.....	.....	8.59	6.62	6.00	5.65	5.61	5.81	5.91	.....	6.62
20	.....	.....	.....	9.19	6.61	6.00	5.65	5.65	5.82	5.89	.....	6.62
21	.....	.....	.....	9.19	6.59	5.85	5.70	5.68	5.79	5.90	5.98	.....
22	.....	.....	9.50	9.08	6.56	5.65	5.68	5.70	5.75	5.91	.....	.....
23	.....	.....	9.40	8.90	6.56	5.56	5.65	5.70	5.74	5.86	.....	.....
24	.....	7.50	9.21	8.81	6.52	5.36	5.68	5.74	5.72	5.90	5.95	.....
25	.....	.....	9.16	8.78	6.52	5.68	5.74	5.74	5.70	5.90	.....	.....
26	7.30	.....	9.11	8.69	6.55	5.72	5.79	5.78	5.62	5.79	.....	.....
27	.....	.....	9.02	8.56	6.54	5.68	5.81	5.78	5.62	5.80	6.22	.....
28	.....	.....	8.99	8.46	6.52	5.65	5.80	5.78	5.65	5.85	.....	6.68
29	.....	.....	8.96	8.38	6.54	5.64	5.81	5.72	5.68	5.80	.....	.....
30	.....	.....	8.98	8.19	6.49	5.62	5.74	5.72	5.68	.....	7.75	.....
31	.....	.....	9.13	.....	6.50	.....	5.74	5.71	.....	.....	.....	.....

NOTE.—Ice present from Jan. 1 to Mar. 21 and from Nov. 1 to Dec. 31.

Daily discharge, in second-feet, of Clearwater River at Red Lake Falls, Minn., for 1910.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Dec.
1	.....	100	1,790	949	166	32	40	37	37	.....
2	.....	100	1,750	910	224	34	36	37	37	.....
3	.....	100	1,680	858	247	33	37	37	37	.....
4	[a] 117	100	1,630	793	257	34	36	40	37	.....
5	.....	100	1,570	715	272	34	36	43	37	.....
6	.....	100	1,480	607	272	36	36	53	37	.....
7	.....	100	1,420	470	272	36	37	48	46	.....
8	.....	100	1,300	415	218	34	37	46	43	.....
9	.....	100	1,190	366	146	33	36	48	43	.....
10	.....	125	1,190	310	153	34	34	43	43	.....

[a] Discharge measurement.

Daily discharge in second-feet, of Clearwater River at Red Lake Falls, Minn., for 1910— Continued.

Day	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Dec.
11		125	1,140	282	157	32	36	38	43	
12		125	1,070	244	142	30	36	40	43	
13		150	1,030	212	144	32	32	38	44	
14		150	923	183	112	32	32	38	48	
15		200	910	178	89	36	34	41	51	
16		200	904	185	79	32	36	48	51	
17		200	884	171	54	32	36	48	49	
18		200	962	178	63	33	32	46	48	
19		250	1,240	171	63	34	32	45	54	[a] 51
20		300	1,710	168	63	34	34	46	52	
21		400	1,710	164	48	37	36	43	53	
22		1,960	1,620	157	34	36	37	40	54	
23		1,880	1,480	157	31	34	37	40	49	
24		1,720	1,410	148	27	36	40	38	53	
25		1,680	1,380	148	36	40	40	37	53	
26		1,640	1,320	155	38	43	43	33	43	
27		1,570	1,220	153	36	45	43	33	44	
28		1,550	1,150	148	34	44	43	34	48	
29		1,520	1,100	153	34	45	38	36	44	
30		1,540	968	142	33	40	38	36	44	
31		1,660		144		40	38		44	

[a] Discharge measurement.

NOTE.—Discharge computed from a well-defined rating curve, except Mar. 1 to 21, when discharge is estimated.

Monthly discharge of Clearwater River at Red Lake Falls, Minn., for 1910.

[Drainage area, 1,310 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January			[a] 220	0.168	0.19	C.
February			[a] 115	.088	.09	C.
March	1,960	100	666	.508	.59	C.
April	1,790	884	1,300	.992	1.11	A.
May	949	142	324	.247	.28	A.
June	272	27	118	.091	.10	B.
July	45	30	35.7	.027	.03	C.
August	43	32	36.7	.028	.03	C.
September	53	33	41.0	.031	.03	C.
October	54	37	45.5	.035	.04	C.
November			[a] 48.0	.037	.04	D.
December			[a] 50.0	.038	.04	D.
The year			250	.191	2.57	

[a] Estimated.

PEMBINA RIVER.

PEMBINA RIVER AT NECHE, N. DAK.

Pembina River rises in Manitoba, flowing from the northern part of Turtle Mountain in a rather crooked easterly course through southern Manitoba and the edge of North Dakota about 130 miles, measured in a direct line, to its mouth at Pembina and St. Vincent. From its junction with the outlet of Pelican Lake to Walhalla, at the foot of First Pembina Mountain, its valley ranges from 175 to 450

feet in depth. Rock Lake and Swan Lake, on this part of the river, are several miles long and from half a mile to a mile wide. At the crossing of the Red River valley the Pembina flows in a channel 20 to 40 feet deep. Its descent from the north base of Turtle Mountain to Walhalla is about 700 feet; and thence to its mouth 186, its junction with Red River being 748 feet above sea level. Long, or White Mud River, Clearwater, or Cypress River, and Tongue River are its chief tributaries, all from the south side.[1]

The gaging station, which was established April 29, 1903, is located at the Great Northern Railway bridge two-thirds of a mile north of Neche, N. Dak.

The records of this stream are necessary to determine the value of the many water-power sites on the Pembina, and are valuable in connection with problems of navigation and flood damages on Red River and in drainage investigations.

The total drainage area above this station is about 2,940 square miles, of which 2,020 are in Manitoba.

The datum of the staff gage, which is spiked to a bridge abutment, has remained unchanged.

A loose-rock dam, about 3 feet high, at the railway water-tank intake pipe, one-third mile below the gage, raises the water at the gage from 1 to 2 feet at low stage. As the dam is changed somewhat by the ice each spring, the lower part of the rating curve requires revision each year. Hence unless several low-stage discharge measurements are made each season the summaries for the low-water season are merely approximate or fair.

Discharge measurements of Pembina River at Neche, N. Dak., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 28	Chandler & Monley	30	15.6	2.36	8.6
28	.....do	16	12.5	2.36	8.6

NOTE.—Wading measurements.

Daily gage height, in feet, of Pembina River at Neche, N. Dak., for 1910.

[Roy Young to May 31, Willie Young to November, observers.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	3.8	3.8	3.3	3.4	2.4	.....	3.8	3.8
2	.....	3.85	3.75	3.3	3.4	2.4	.....	3.7	3.8
3	.....	3.8	3.7	3.35	3.2	2.4	.....	3.7	3.7
4	.....	3.7	3.65	3.3	3.2	2.4	.....	3.7	.....
5	.....	3.7	3.6	3.4	3.2	2.2	.....	3.7	.....
6	.....	3.8	3.6	3.35	3.0	2.2	.....	3.7	.....
7	.....	3.8	3.6	3.3	3.0	2.2	.....	3.7	.....
8	.....	3.75	3.5	3.2	3.0	2.2	.....	3.8	.....
9	.....	3.8	3.5	3.2	3.0	2.2	.....	3.8	.....
10	.....	3.7	3.55	3.2	3.0	2.1	2.5	4.0	.....

[1] Description abstracted from Report of exploration of the glacial Lake Agassiz in Manitoba, by Warren Upham: Geol. and Nat. Hist. Survey Canada, new ser., vol. 4, 1888–89, p. 23 E.

Daily gage height, in feet, of Pembina River at Neche, N. Dak., for 1910—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	.....	3.7	3.5	3.2	3.0	2.1	2.7	4.0	.....
12	.....	3.75	3.5	3.2	3.0	2.3	2.7	4.0	.....
13	.....	3.8	3.55	3.2	2.8	2.3	3.2	4.0	.....
14	.....	3.8	3.6	3.1	2.8	2.3	3.4	4.0	.....
15	6.5	3.8	3.5	3.1	2.8	2.3	3.5	4.0	.....
16	6.5	3.75	3.5	3.1	2.8	2.3	3.7	4.0	.....
17	6.0	3.75	3.55	3.1	2.8	2.4	3.7	3.9	.....
18	5.7	3.7	3.5	3.1	2.8	2.4	3.7	3.9	.....
19	5.6	4.0	3.5	3.1	2.5	2.4	3.7	3.8	.....
20	5.3	4.3	3.5	3.1	2.5	2.4	3.7	3.7	.....
21	5.3	4.1	3.6	3.0	2.5	2.4	3.7	3.9	.....
22	4.8	4.0	3.6	3.0	2.5	2.4	3.7	3.9	.....
23	5.4	4.0	3.55	3.0	2.5	2.4	3.8	3.9	.....
24	4.15	3.8	3.5	2.8	2.5	2.4	3.8	3.9	.....
25	3.8	3.7	3.5	2.8	2.5	.....	3.9	4.0	.....
26	3.8	3.7	3.4	2.8	2.4	.....	3.9	4.0	.....
27	3.7	3.8	3.35	2.5	2.4	.....	3.9	3.8	.....
28	3.6	3.7	3.3	2.5	2.4	.....	3.9	3.8	.....
29	3.5	3.7	3.3	2.3	2.4	.....	3.9	3.8	.....
30	3.8	3.7	3.4	.....	2.4	.....	3.9	3.8	.....
31	3.9	.....	3.4	.....	2.4	.....	.....	3.8	.....

NOTE.—Ice present from Jan. 1 to Mar. 14 and from Nov. 4 to Dec. 31. From Aug. 25 to Sept. 9 the gage height was less than 2.2 feet. The rock dam was raised approximately 1.6 feet from Sept. 10 to Sept. 16. This had no effect on the discharge.

Daily discharge, in second-feet, of Pembina River at Neche, N. Dak., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	164	164	86	100	10	3	5
2	.....	172	156	86	100	10	3	3
3	.....	164	147	93	73	10	3	3
4	.....	147	139	86	73	10	3	3
5	.....	147	131	100	73	5	3	3
6	.....	164	131	93	49	5	3	3
7	.....	164	131	86	49	5	3	3
8	.....	156	115	73	49	5	3	5
9	.....	164	115	73	49	5	3	5
10	.....	147	123	73	49	4	3	10
11	.....	147	115	73	49	4	3	10
12	.....	156	115	73	49	7	3	10
13	.....	164	123	73	27	7	3	10
14	.....	164	131	61	27	7	3	10
15	685	164	115	61	27	7	3	10
16	685	156	115	61	27	7	3	10
17	580	156	123	61	27	10	3	7
18	518	147	115	61	27	10	3	7
19	498	198	115	61	14	10	3	5
20	438	250	115	61	14	10	3	3
21	438	215	131	49	14	10	3	7
22	341	198	131	49	14	10	3	7
23	458	198	123	49	14	10	5	7
24	224	164	115	27	14	10	5	7
25	164	147	115	27	14	4	7	10
26	164	147	100	27	10	4	7	10
27	147	164	93	14	10	4	7	5
28	131	147	86	14	10	4	7	5
29	115	147	86	7	10	3	7	5
30	164	147	100	54	10	3	7	5
31	181	.....	100	.....	10	3	.....	5

NOTE.—Discharge computed on a well-defined rating curve, except from Sept. 10 to Oct. 31, when it was estimated because of a change in the control.

Monthly discharge of Pembina River at Neche, N. Dak., for 1910.

[Drainage area, 2,940 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
March 15–31	685	115	349	0.118	0.08	11,800	B.
April	250	147	166	.056	.06	9,880	B.
May	164	86	120	.041	.05	7,380	C.
June	100	7	60.4	.020	.02	3,590	C.
July	100	10	34.9	.012	.01	2,150	C.
August	10	3	6.87	.0023	.003	422	D.
September	7	3	3.93	.0013	.001	234	D.
October	10	3	6.39	.0022	.003	393	D.
The period						25,200	

MOUSE RIVER.

GENERAL FEATURES OF AREA DRAINED.

Mouse (or Souris) River rises in the southeastern part of the Province of Saskatchewan, Canada, and flows southeastward 230 miles to the northern boundary of North Dakota; thence it continues in a southeasterly direction for 80 miles to the southwestern part of McHenry County, where it makes a loop by swinging to the northeast, north, and northwest, and in 90 miles reaches the Canadian boundary again; thence it flows north and east 120 miles through the Province of Manitoba to Assiniboine River, which discharges into Red River 120 miles farther east, at Winnipeg.

The drainage area above the point where the river enters the United States is about 7,200 square miles, nine-tenths of this area being in Saskatchewan and the remainder comprising a narrow strip along the northern edge of North Dakota. Above the point where the river leaves the United States the total drainage area is about 12,000 square miles.

The Mouse has only three important tributaries in North Dakota—Des Lacs River, draining about 700 square miles, and Cut Bank and Willow creeks, draining each about 1,100 square miles. All three streams flow from a rolling prairie whose surface was left uneven by the ice of the glacial epoch and whose drainage is imperfectly developed. Hence in ordinary years the run-off from only a small portion of the drainage area—perhaps one-fourth—reaches the streams, but the water stands in scattered pools and lakelets that dry away through the season. In unusually wet or stormy years these pools and sloughs overflow, causing abnormal increases in the flow of the river.

The whole area is deeply covered with glacial drift, except a portion of the "Mouse River loop," which is covered with silt and is more

level, having been in the glacial epoch the bottom of Lake Souris, an arm of Lake Agassiz, which filled the Red River valley at that time.

The elevation of this drainage basin is 1,450 feet above sea level at the lowest point in North Dakota and about 2,000 feet at its western margin in North Dakota.

In the upper part of its course the river occupies a valley a hundred feet deep and a mile wide; after turning north around the loop, it runs through a prairie scarcely above the water level. The whole stretch in North Dakota is very sluggish on account of its small fall, and in the last 40 miles before the river reenters Canada its total fall is only 8 feet.

The area is without forests or trees except small scattered clumps or groves on the steep hillsides and fringes along the streams. The mean annual rainfall is from 13 to 17 inches, half of which falls in the three months of May, June, and July.

During the winter the streams are closed for at least four months, and the flow beneath the ice is very small. Thaws sufficient to cause any considerable rise or flood in winter are unknown.

The stations in the Mouse River basin were established to determine the practicability of irrigation, and the records have shown that (except in years so wet that the irrigation would be of little value) the flow of the streams is too small to justify as expensive construction as would be necessary for extensive irrigation works in a country of such small slope. The station records are now found to be essential for investigating the methods of reclamation by drainage in the Mouse River loop, and for flood prevention.

The tributaries afford some storage sites, as, for example, at Des Lacs Lakes on Des Lacs River, but losses by evaporation would be so great that this storage would probably be useless except for flood prevention.

MOUSE RIVER AT MINOT, N. DAK.

This station, which is located north of the Great Northern Railway roundhouse, at Minot, N. Dak., was established May 5, 1903.

Des Lacs River enters 7 miles above the station.

The original staff gage was located at a footbridge near the roundhouse. This bridge was removed June 28, 1909, but the gage was left undisturbed. On December 28, 1909, a new staff gage was installed at the Anne Street Bridge about 40 rods downstream. Both gages read practically the same because of the flat slope of the river. The character of the channel remains nearly constant. Gage heights at low stages are controlled by a 3-foot rock-filled dam with plank core wall at the "Soo" Railway water tank, a mile below the former location of the gage. At extreme low water this dam raises the water at the gage about 2 feet. During the summer of

1904 the dam was rebuilt and has since remained practically unchanged. It has an approximately level crest. Weir formulas have been found to apply satisfactorily except at extreme low stages, when the slight leakage has to be considered. A good rating curve for nearly all stages has been developed.

Discharge measurements of Mouse River at Minot, N. Dak., 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 21[a]	E. F. Chandler	48	28.8	3.89	19.6
Oct. 21[b]	do			3.01	0.6

[a] Wading section. [b] Float measurement.

Daily gage height, in feet, of Mouse River at Minot, N. Dak., for 1910.

[Ephraim Cox, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		4.85	4.55	4.2	4.0	3.75		3.05	3.0
2		4.85	4.55	4.2	4.0	3.75		3.05	3.0
3		4.85	4.55	4.2	3.95	3.75		3.05	3.0
4		4.85	4.5	4.2	3.95	3.75		3.05	3.0
5		4.8	4.5	4.1	3.95	3.75		3.05	3.0
6	4.15	4.8	4.5	4.1	3.95	3.7		3.0	3.0
7	4.25	4.75	4.5	4.05	4.0	3.7		3.0	3.0
8	4.35	4.75	4.5	4.05	4.0	3.7		3.0	3.0
9	4.4	4.7	4.5	4.1	4.0	3.65		3.0	3.0
10	4.45	4.7	4.45	4.1	4.0	3.65		3.0	3.0
11	4.5	4.7	4.45	4.1	3.95	3.65		3.0	3.0
12	4.6	4.7	4.45	4.1	3.95	3.65		3.0	3.0
13	4.7	4.65	4.45	4.1	3.90	3.2		3.0	3.0
14	4.75	4.65	4.4	4.1	3.90	3.2		3.0	3.05
15	4.7	4.65	4.4	4.1	3.85	3.15	3.0	3.0	3.05
16	4.65	4.65	4.35	4.1	3.8	3.1	3.0	3.0	3.05
17	4.65	4.6	4.35	4.1	3.8	3.0	3.05	3.0	3.05
18	4.6	4.6	4.35	4.1	3.8		3.05	3.0	3.05
19	4.55	4.6	4.35	4.1	3.8		3.05	3.0	3.05
20	4.55	4.6	4.35	4.0	3.85		3.05	3.0	3.05
21	4.6	4.55	4.35	4.0	3.85		3.05	3.0	3.05
22	4.6	4.55	4.35	4.0	3.85		3.0	3.0	3.1
23	4.55	4.6	4.35	3.95	3.85		3.0	3.0	3.1
24	4.55	4.7	4.35	3.95	3.85		3.0	3.0	3.15
25	4.6	4.8	4.35	3.95	3.8		3.0	3.0	3.15
26	4.65	4.75	4.35	3.95	3.8		3.0	3.0	3.20
27	4.65	4.6	4.3	4.0	3.8		3.0	3.0	3.25
28	4.7	4.6	4.3	4.0	3.8		3.05	3.0	
29	4.75	4.6	4.3	4.0	3.8		3.05	3.0	
30	4.8	4.55	4.25	4.0	3.8		3.05	3.0	
31	4.8		4.25		3.8			3.0	

NOTE.—Ice present from Jan. 1 to Mar. 6 and from Nov. 28 to Dec. 31. Gage heights below 3 feet from Aug. 18 to Sept. 14.

Daily discharge, in second-feet, of Mouse River at Minot, N. Dak., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	6	207	141	70	38	7	0.2	0.6	0.5
2	8	207	141	70	38	7	.2	.6	.5
3	10	207	141	70	35	7	.2	.6	.5
4	20	207	130	70	35	7	.2	.6	.5
5	30	196	130	52	35	7	.2	.6	.5
6	61	196	130	52	35	4.5	.2	.5	.5
7	79	185	130	43	38	4.5	.2	.5	.5
8	99	185	130	43	38	4.5	.2	.5	.5
9	109	174	130	52	38	2.5	.2	.5	.5
10	119	174	119	52	38	2.5	.2	.5	.5

Daily discharge, in second-feet, of Mouse River at Minot, N. Dak., for 1910—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	130	174	119	52	35	2.5	0.3	0.5	0.5
12	152	174	119	52	35	2.5	.3	.5	.5
13	174	163	119	52	21	.7	.3	.5	.5
14	185	163	109	52	21	.7	.3	.5	.6
15	174	163	109	52	15	.6	.5	.5	.6
16	163	163	99	52	10	.6	.5	.5	.6
17	163	152	99	52	10	.5	.6	.5	.6
18	152	152	99	52	10	.4	.6	.5	.6
19	141	152	99	52	10	.4	.6	.5	.6
20	141	152	99	35	15	.4	.6	.5	.6
21	152	141	99	35	15	.3	.6	.5	.6
22	152	141	99	35	15	.3	.5	.5	.6
23	141	152	99	28	15	.3	.5	.5	.6
24	141	174	99	28	15	.3	.5	.5	.6
25	152	196	99	28	10	.3	.5	.5	.6
26	163	185	99	28	10	.3	.5	.5	.7
27	163	152	89	35	10	.3	.5	.5	.7
28	174	152	89	35	10	.3	.6	.5	.7
29	185	152	89	35	10	.3	.6	.5	.7
30	196	141	79	35	10	.3	.6	.5	.7
31	196	.....	79	.....	10	.3	.....	.5	.....

NOTE.—Discharge computed from a rating curve well defined between 36 and 2,600 second-feet. Below 36 second-feet the curve is only fairly well defined. From Mar. 1 to 5, Aug. 18 to Sept. 14, and Nov. 28 to 30 the discharge is estimated.

Monthly discharge of Mouse River at Minot, N. Dak., for 1910.

[Drainage area, 8,400 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	[a] 0.5	0.000060	0.00007	31	D.
February	.....	.....	[a] .5	.000060	.00006	28	D.
March	196	.....	127	.015	.02	7,810	A.
April	207	141	171	.020	.02	10,200	A.
May	141	79	110	.013	.01	6,960	A.
June	70	28	46.6	.0055	.01	2,770	A.
July	38	10	21.9	.0026	.003	1,350	B.
August	7	.3	2.13	.00025	.0003	131	C.
September	.6	.2	.40	.000048	.00005	24	C.
October	.6	.5	.52	.000061	.00007	32	C.
November	.7	.5	.57	.000068	.00008	34	C.
December	.....	.....	[a] .5	.000060	.00007	31	D.
The year	207	.....	40.1	.0047	.06	30,400	

[a] Estimated.

EVAPORATION AT UNIVERSITY, N. DAK.[1]

The evaporation gage at University, N. Dak., was established April 17, 1905. It is located on a pool in a ravine called English Coulee, which runs through the campus of the University of North Dakota, which is immediately west of Grand Forks, N. Dak., and 2 miles west of the Minnesota boundary.

[1] For complete description of this station and records of evaporation, rainfall, and temperature for 1905, 1908, see Water-Supply Paper U. S. Geol. Survey No. 245, p. 64–67.

The coulee drains about 60 square miles of very level prairie. Except for brief freshets the flow in the coulee is small, varying from 1 second-foot or less to 20 second-feet. In very dry weather the water lies in pools with scarcely any perceptible flow.

A heavy galvanized-iron tank, 3 feet square and 18 inches deep, is placed in the center of an anchored raft, so that the water in the tank is at the same level as the water surface outside. The tank is filled nearly to the top, to a height precisely marked by the pointed tip of a vertical rod in the center of the tank. Once each day, after the change produced by evaporation or rainfall, the water level is restored to the original height, the precise amount of water transferred being measured with a cup of such size that one cupful of water is equivalent to 0.01 inch depth in the tank.

A standard rain gage is located on the open prairie about 10 rods distant. On days of rainfall the difference (which is usually small) between the quantity measured by the rain gage and the surplus in the tank is considered the total evaporation for the day. Observations were made usually about 6 p. m. The water temperature is the mean temperature of the water at that hour; the air temperature is the mean of the maximum and minimum thermometer readings for each day. On account of the unusually dry weather in 1910, the evaporation was greater than in any previous year since this gage was established.

Results of observations of evaporation, rainfall, and temperature for 1910 are presented in the following table:

Evaporation, rainfall, and temperature at University, N. Dak., for 1910.

[Observer, W. R. Holgate.]

Date.	Evaporation.	Rainfall.	Temperature of—	
			Water.	Air.
	Inches.	*Inches.*	*°F.*	*°F.*
Apr. 3–10	0.95	0.11	47	50
Apr. 11–20	.74	.78	40	42
Apr. 21–30	1.12	.24	40	47
May 1–10	1.50	.00	51	48
May 11–20	1.59	.67	52	49
May 21–31	1.99	.04	54	53
June 1–10	1.63	.63	60	53
June 11–20	2.63	.05	73	74
June 21–30	2.69	.00	77	77
July 1–10	2.58	.09	70	73
July 11–20	2.06	.54	72	74
July 21–31	2.37	.13	67	70
Aug. 1–10	1.50	.40	70	66
Aug. 11–20	1.80	.09	71	65
Aug. 21–31	1.46	.41	61	61
Sept. 1–10	1.04	2.69	60	57
Sept. 11–20	.90	.00	60	55
Sept. 21–30	1.09	.35	55	54
Oct. 1–10	1.29	.00	55	56
Oct. 11–20	1.25	.56	50	50
Oct. 21–31	.78	.05	40	39
Total for period	32.96	7.83	.....	.....

RAINY RIVER.

GENERAL FEATURES OF AREA DRAINED.

Rainy River connects Rainy Lake with Lake of the Woods, but above Rainy Lake is a succession of lakes connected by rapids, at the head of which, in T. 65 N., R. 2 W. on the international boundary, is North Lake. From North Lake a stream flows westward, passing through Gunflint, Pine, Granite, Saganaga, Otter Track, Knife, Sucker, Basswood, Crooked, and Iron lakes, Lac La Croix, and Namekan River into Rainy Lake. With the exception of Namekan River, whose course lies in Ontario, these waters form a portion of the boundary between Minnesota and Canada, but no general term other than "boundary waters" has been applied to the chain above Rainy Lake.

The principal American tributaries of the boundary waters are Cross River, which flows through Kaskadinna, Sucker, and Ham lakes into Gunflint Lake; a line of drainage passing through Charley, Bashitanaqueb, Greenwood, East and West, Little Saganaga, Gabimichigami, Ogishke-Muncie, Frog Rock, West Sea Gull, and Sea Gull lakes and emptying into Saganaga Lake; Kawishiwi River, which rises in Syenite Lake and flows through Polly, Boulder, Alice, Wilder, Crab, Copeland, Birch, White-Iron, Garden, Fall, and Newton lakes into Basswood Lake; Loon River, which enters Loon Lake and flows through Little Vermilion and Sand Point lakes into Namekan Lake; Vermilion River, which flows through Crane and Sand Point lakes into Namekan Lake; Ash River, which flows through Kabetogama Lake into Namekan Lake; Rat Root River, which flows into Rainy Lake; and Little Fork, Big Fork, Black, Rapid, and Winterroad rivers, which discharge into Rainy River.

The chief Canadian tributaries are a line of drainage through Weikwabinonaw, Koss, and Northern Light lakes into Saganaga Lake; Maligne River, which drains a region thickly dotted with lakes (the largest being Pickerel and Sturgeon lakes) and discharges into Lac La Croix; Pipestone, Manitou, Turtle, and Otukamamoan Lake outlets, which enter Rainy Lake; and La Valle and Pine rivers, which enter Rainy River.

The following drainage areas have been measured in the basin:

Drainage areas in Rainy River basin.

River.	Above—	Drainage area.
		Sq. miles.
Rainy	International Falls	[a] 14,600
Do	Lake of the Woods Inlet	[a] 20,800
Cross	Mouth	61
Kawishiwi	Forks	242
Do	Mouth	1,410
Stony	....do	254
Burntside	....do	146
Ash	....do	146
Rat Root	....do	283
Black	West Fork	288
Do	Mouth	408
Warroad	....do	256

[a] Revised since 1909 report.

Above Rainy Lake the drainage area is rough and hilly and thickly dotted with lakes which lie in rock-bound basins and have outlet over rocky rims that have been little eroded. The southern boundary of this part of the drainage area is a broad undulating plateau which rises 1,800 to 1,900 feet above sea level. This is the region of light glacial drift or bare rocks, the latter comprising granites, gneisses, mica schists, gabbros, and greenstones. The valleys of the Vermilion and other rivers show a thin layer of fine clay, probably deposited by a glacier-dammed lake.

West of Rainy Lake the basin is deeply covered with glacial drift, lakes are rare, and the country is, for the most part, flat with a few hills rising 50 to 75 feet above the plain. During the glacial period this part of the basin was covered by a lake, now called Lake Agassiz, and in consequence the surface is very smooth. The northward slope of the area south of Rainy River is insufficient to afford good drainage and extensive tracts are swampy. In general dry land is only found along the banks of the streams which flow in very tortuous channels cut 5 to 40 feet below the general surface level. Settlers are few except along the streams, as the infrequent roads are almost impassable during the open season.

Between the southern end of Bow String Lake and Lake Winnibigoshish is a continuous river valley that during high stages affords water connection between Mississippi River and Hudson Bay. In the eastern portion of the area there is probably a connection between North Lake in the Hudson Bay drainage area and South Lake in the Lake Superior drainage area. Altitudes in the Rainy River basin range from 1,025 to 2,000 feet above sea level.

The portion of the drainage area in Minnesota and probably also that in Ontario lies within the forested region and contains very little cleared land. East of Rat Root River are tracts of dense timber interspersed with patches of thin timber. The western part of the basin is covered with dense, heavy forests, in which white and Norway pine, spruce, cedar, balsam, and tamarack are the principal growths. In the extreme western end of the basin, south of Lake of the Woods, are extensive areas of muskeg which are covered with short, scrubby, fairly dense growths of black spruce.

Many of the tributary streams are used for driving logs which are carried either to International Falls or to Baudette and Spooner.

As no rainfall records have been kept within the Rainy River area for any considerable time, the rainfall is not known accurately, but stations outside the basin indicate a probable mean annual precipitation of 30 inches or more in the extreme eastern portion with a decrease to some 24 inches at Lake of the Woods. The annual snowfall equals about 5½ inches of the precipitation. From November to March (except at falls) the streams are frozen over and the ground is covered with several feet of snow. The melting of this snow causes very high water on rivers uncontrolled by lakes or other natural storage; on streams fed by many lakes the rise is much less.

The best reservoir sites are the lakes forming the boundary waters, of which the largest (excepting Lake of the Woods) is Rainy Lake. This lake embraces about 344 square miles and is thickly dotted with islands. The power dam at International Falls is said to store water on Rainy Lake to a depth of 4 feet. Beside the reservoir sites afforded by the boundary waters other sites can be found on the tributary streams, notably on Vermilion Lake and River and Kawishiwi River in Minnesota, and the larger of the numberless lakes in Canada.

The following table of elevations and distances along the boundary waters is presented to give an idea of the available power. Above Basswood Lake the elevations are only approximate, being largely aneroid readings taken from the final report of the Minnesota Geological Survey. Below that point the elevations are based on a survey made by E. B. Banks, city engineer of Superior, Wis., and furnished the United States Geological Survey through his courtesy.

Elevations and distances along boundary waters.

Point.	Distance below North Lake outlet.	Elevation above sea level.
	Miles.	*Feet.*
North Lake	0	1,550
Gun Flint Lake	0.5– 8	1,547
Pine Lake	10 – 12.5	1,465
Granite Lake	15.5– 21.5	1,448
Saganaga Lake	22.5– 32.5	1,434
Ottertrack Lake	34 – 39	1,385
Knife Lake	39.5– 49	1,381
Carp Lake	51 – 52	1,335
Sucker Lake	53 – 57	1,330
Basswood Lake	57.5– 84	1,299
Crooked Lake	88 –104	1,246
Iron Lake	105 –108	1,217
Lac La Croix	109 –125	1,183
Namekan Lake	143 –161	1,115
Rainy Lake	161.5–201	1,106
Top of dam, International Falls	203	1,106
Foot of dam, International Falls	203	1,077
Head Manitou Rapids	236	1,069
Foot of Manitou Rapids	236.5	1,068
Head Long Sault	243.5	1,065
Foot Long Sault	245.5	1,060
Lake of the Woods	254	1,054

In order to determine the availability of the South Branch of the Kawishiwi for water-power development and storage, a survey was made during 1911 from Birch Lake to Fall Lake. From the data collected on this survey sheets have been prepared showing a profile of the water surface, a plan of the river and the lakes through which it flows, and the contours on the river and lake banks. These sheets have been prepared separately and may be obtained by applying to the district engineer, United States Geological Survey, Old Capitol Building, St. Paul, Minn.

The following tables of approximate elevations and distances have been compiled chiefly from the State drainage engineer's "Report on the topographical survey of Minnesota" and from the reports of the Minnesota Geological Survey:

Elevations and distances along streams in Rainy River basin.

Place.	Distance above mouth.	Elevation.
Cross River.	*Miles.*	*Feet.*
Gunflint Lake	0	1,547
Sec. 26, T. 65 N., R. 4 W	2	1,600
Ham Lake outlet	4	1,706
Sucker Lake outlet	7	1,740
Kaskadinna Lake outlet	10	1,767
Kawishiwi River.		
Basswood Lake	0	1,299
Newton Lake outlet	8	1,307
Fall Lake outlet	11	1,313
Fall Lake inlet	14.5	1,313
Garden Lake outlet	15	1,384
Farm Lake outlet	18	1,386
Friday Lake outlet	19	1,388
Junction of branches	27	1,451
Crab Lake outlet	31	1,487

Elevations and distances along streams in Rainy River basin—Continued.

Place.	Distance above mouth.	Elevation.
Kawishiwi River—Continued.	*Miles.*	*Feet.*
Sec. 31, T. 63 N., R. 8 W	39	1,503
Wilder Lake outlet	44	1,540
Lake Alice outlet	50	1,544
Range line 6-7	56	1,560
Sec. 8, T. 63 N., R. 6 W	61	1,580
Boulder Lake outlet	62	1,587
Polly Lake outlet	64	1,617
Township line 62-63	67	1,714
Syenite Lake outlet	69	1,777
Rat Root River.		
Rat Root Lake	0	1,117
Sec. 3, T. 69 N., R. 23 W	8	1,120
Sec. 10, T. 69 N., R. 24 W	16	1,125
Range line 23-24	27	1,128
Sec. 18, T. 68 N., R. 22 W	38	1,144
Black River.		
Rainy River	0	1,078
Road Crossing	9	1,086
Settler	12	1,095
Secs. 34-35	14	1,106
Sec. 27, T. 158 N., R. 27 W	23	1,122
Brook	26	1,126
Sec. 16, T. 157 N., R. 27 W	32	1,155
Sec. 28, T. 157 N., R. 27 W	34	1,163
Rapid River.		
Rainy River	0	1,061
Sec. 19, T. 160 N., R. 29 W	4	1,073
Sec. 31, T. 160 N., R. 29 W	6	1,074
Sec. 1, T. 158 N., R. 31 W	28	1,098
Sec. 1, T. 158 N., R. 32 W	36	1,140
Warroad River.		
Lake of the Woods	0	1,057
Sec. 12, T. 162 N., R. 37 W	8	1,080
Sec. 23, T. 162 N., R. 37 W	10	1,090
Sec. 26, T. 162 N., R. 37 W	11	1,100
Sec. 26, T. 162 N., R. 37 W	13	1,110
Sec. 12, T. 161 N., R. 37 W	16	1,120
Sec. 13, T. 161 N., R. 37 W	17	1,130
Sec. 20, T. 161 N., R. 36 W	19	1,152
Sec. 6, T. 160 N., R. 36 W	23	1,200

Most of the streams in the basin have a good fall and many of them afford excellent power sites. By far the best site, and the only one utilized at the present time, is that at International Falls, where 12,000 horsepower is being developed on the American side and 8,000 on the Canadian. This power is used largely in operating the paper mill located at the American power site.

Although the basin includes a vast amount of swamp land, the country is so undeveloped that little drainage work has been undertaken. About 40,000 acres have been drained in Koochiching County.

Rainy River is navigable for small steamers between International Falls and Lake of the Woods. The Canadian Government is investigating the river with a view to improving navigation by building locks on the Long Sault and Manitou Rapids.

An examination of the ceded Chippewa lands in Rainy River basin was made by the United States Geological Survey, and the results (including a plan for drainage) were published in House Document 27, Sixty-first Congress, first session. The report contains a list of bench-mark stations and a topographic map (with 10-foot contours) on a scale of 1:125,000.

The quality of the water in Rainy River is described in a report entitled "The quality of surface waters in Minnesota," published by the United States Geological Survey as Water-Supply Paper 193.

RAINY RIVER AT INTERNATIONAL FALLS, MINN.

This station, which was established by the Minnesota & Ontario Power Co. March 1, 1907, is located at the American power house just below the dam at International Falls. As the dam controls the stage of water in Rainy Lake, this latter acts as a reservoir, and accordingly any change of water surface in the lake indicates that the natural run-off of Rainy River at International Falls is being increased or partially withheld. Therefore it is necessary to know the changes of lake level in order to determine the natural run-off from the Rainy River basin. These data are of value in connection with studies of water power and navigation.

The gage heights have been furnished through the courtesy of the power company. In 1909 the Geological Survey began to rate the section by means of discharge measurements made from a boat and cable several hundred yards below the gage. (See Pl. III, *B*.) When that rating is completed it will be possible to estimate the daily discharge since 1907, as conditions of flow are practically permanent. During the latter part of 1909 a portion of the natural run-off was held back to fill the reservoir.

Discharge measurements of Rainy River at International Falls, Minn., 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 6	G. A. Gray	564	8,300	466.72	11,40
June 23	C. R. Adams	523	7,410	[a] 465.74	10,60

[a] Gage height rose 0.53 foot during measurement.

Daily gage height, in feet, of Rainy River at International Falls, Minn., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	467.95	467.00	467.36	467.16	466.76	464.86	465.46	a461.66	462.66	462.36	463.55	463.86
2	.....	467.00	467.26	467.16	466.86	465.86	465.56	463.16	462.46	.....	461.24	463.86
3	468.08	467.10	467.06	467.16	466.86	464.86	465.56	463.16	462.46	462.26	463.46	464.01
4	.....	467.10	466.86	466.86	466.76	464.86	465.50	463.36	462.46	462.26	463.66	.....
5	468.06	467.35	466.86	466.76	466.76	464.86	464.46	463.21	462.46	462.26	463.66	a462.66
6	468.05	.....	466.76	466.66	466.76	465.16	465.06	463.21	462.46	462.26	.....	463.36
7	468.11	467.15	466.66	466.66	466.76	466.26	464.86	a461.76	462.46	463.04	a461.21	463.36
8	468.14	467.15	466.61	466.50	466.76	465.86	463.96	462.66	462.46	462.76	463.51	463.96
9	.....	467.10	466.56	466.46	466.76	466.86	463.81	463.26	462.46	462.76	463.51	464.06
10	468.05	467.45	466.56	.....	466.96	466.66	463.36	462.76	462.46	a460.42	463.53	464.16
11	468.03	467.30	.....	466.05	467.06	466.86	463.86	462.26	462.46	462.96	463.51	.....
12	468.04	467.30	.....	466.06	467.26	466.86	463.56	462.56	462.46	462.96	463.61	462.66
13	467.92	.....	.....	465.96	467.26	466.36	463.76	462.66	462.56	463.11	.....	463.16
14	467.90	467.30	.....	465.96	465.46	466.86	463.66	a461.96	462.36	463.26	462.76	463.06
15	467.85	467.36	465.91	465.96	465.46	466.56	463.56	461.96	462.36	463.36	463.51	463.76
16	.....	467.66	.....	465.96	465.56	466.61	463.36	461.96	462.36	a460.22	463.61	463.56
17	467.55	.....	.....	466.06	465.56	466.56	463.36	462.46	462.36	461.26	463.76	463.56
18	467.65	.....	.....	466.26	465.96	464.81	a461.36	462.46	462.46	462.61	463.86	.....
19	467.65	.....	.....	466.76	466.26	464.81	463.21	462.56	462.46	463.11	464.21	a461.46
20	467.65	.....	.....	467.56	464.41	464.86	463.16	462.56	462.46	463.16	.....	463.16
21	467.66	467.56	465.66	467.96	465.01	464.86	463.06	462.56	462.46	463.11	463.76	463.46
22	467.54	467.56	465.50	467.96	464.46	465.46	462.76	462.56	462.46	463.21	464.86	463.56
23	.....	467.56	465.36	467.96	466.36	465.26	462.36	461.46	462.46	.....	464.46	463.10
24	467.40	467.56	466.16	467.96	466.36	465.96	462.36	462.56	462.46	461.35	464.16	463.00
25	467.40	467.56	465.76	467.50	465.86	465.86	462.30	462.66	462.46	463.54	464.26	.....
26	467.25	467.56	466.36	467.15	464.86	465.86	462.16	462.66	462.56	463.54	464.06	.....
27	.....	.....	466.50	467.15	465.56	465.36	462.00	462.75	462.36	463.51	.....	a461.40
28	467.20	467.26	466.36	466.76	465.50	465.36	462.00	463.66	462.46	463.45	a461.76	462.86
29	467.10	.....	456.76	466.76	465.50	465.36	462.86	a461.46	462.46	463.46	463.36	462.56
30	467.15	.....	466.76	466.56	465.25	465.06	463.06	462.86	462.36	.....	463.86	462.66
31	467.15	.....	467.06	.....	465.25	.....	463.16	462.76	.....	462.74	.....	462.76

a Low water caused by closing of dam on Sunday.

NOTE.—Gage heights were affected by presence of ice during the winter months.

RAINY LAKE NEAR RANIER, MINN.

This station is located above the Minnesota & Ontario Power Co.'s dam at International Falls, 2 miles below Ranier. Although there is a slope of several tenths of a foot between the water surface at the dam and that of the lake, the surface of the latter is controlled by the dam. Thus any change of stage in the lake indicates that the natural run-off is not passing the dam. Rainy Lake has an approximate area of 344 square miles but its effective reservoir capacity is somewhat uncertain, owing to the many small islands in the lake. The existing maps are too small to indicate accurately the areas of these islands.

The gage heights given herewith are furnished through the courtesy of the power company. By adding 460.82 feet the gage heights are referred to the same datum as the gage heights of Rainy River.

Daily gage height, in feet, of Rainy Lake River near Ranier, Minn., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.45	6.90	5.55	4.90	6.15	6.05	4.85	4.55	3.75	2.95	1.30	0.30
2	.....	6.90	5.55	4.90	6.15	5.90	4.65	4.50	3.80	.....	2.20	.20
3	7.48	6.85	5.55	5.00	6.15	6.05	4.65	4.25	3.80	2.80	1.15	.10
4	.....	6.85	5.55	5.05	6.15	6.20	4.65	4.35	3.80	2.75	1.07	.....
5	7.47	6.80	5.55	5.15	6.15	6.20	4.65	4.35	3.80	2.45	.95	.00
6	7.47	.....	5.55	5.25	6.15	6.15	4.55	4.35	3.80	2.51	.....	.30
7	7.42	6.65	5.45	5.25	6.15	5.75	4.75	4.35	3.75	2.49	.90	+.10
8	7.40	6.65	5.35	5.35	6.15	5.95	4.80	4.15	3.75	2.35	.80	−.14
9	.....	6.55	5.25	5.35	6.10	5.55	4.85	4.25	3.75	2.35	.80	−.15
10	7.38	6.50	5.25	5.35	5.95	5.35	4.95	4.35	3.75	2.35	.70	−.27
11	7.37	6.45	5.00	5.45	5.85	5.35	4.85	4.35	3.75	2.35	.66	.00
12	7.35	6.45	5.00	5.45	5.65	5.35	4.90	4.35	3.75	2.50	.6	.00
13	7.35	.....	5.00	5.45	6.30	5.30	4.85	4.35	3.65	2.35	.....	+.20
14	7.30	6.35	4.97	5.45	6.30	5.20	4.75	4.35	3.45	2.35	.6	+.22
15	7.25	6.30	4.93	5.55	6.30	5.25	4.75	4.35	3.35	1.85	.5	−.15
16	.....	6.25	4.75	5.55	6.25	5.25	4.90	4.25	3.30	2.75	.35	−.10
17	7.28	.....	4.75	5.75	6.25	5.25	4.90	4.25	3.25	2.55	.30	−.10
18	7.25	.....	4.70	5.75	6.10	5.65	4.75	4.20	3.15	2.10	.20	.....
19	7.25	.....	4.65	5.90	6.15	5.65	4.60	4.10	3.15	2.40	.30	+.08
20	7.24	.....	4.65	6.05	6.45	5.55	4.55	4.10	3.15	2.11	.....	−.25
21	7.25	5.95	4.65	6.05	6.35	5.50	4.55	4.10	3.15	2.07	.5	−.25
22	7.15	5.90	4.75	5.95	6.35	5.25	4.65	4.05	3.15	2.00	.05	−.20
23	.....	5.85	4.75	5.95	6.25	5.30	4.70	4.05	3.20	.....	.60	.00
24	7.10	5.85	4.65	5.95	6.10	5.15	4.70	4.05	3.15	2.32	.50	.00
25	7.10	5.85	4.65	6.10	6.35	5.05	4.75	4.00	3.25	1.74	.4	.....
26	7.05	5.75	4.70	6.15	6.35	5.05	4.55	3.85	3.05	1.71	.4	+.10
27	.....	.....	4.70	6.25	6.10	5.05	4.75	3.90	3.05	1.61	.....	−.15
28	7.00	5.65	4.65	6.10	5.85	5.00	4.65	3.90	3.00	1.60	.60	−.35
29	6.95	.....	4.75	6.15	5.95	5.00	4.45	3.90	3.05	1.55	.60	−.35
30	6.90	.....	4.85	6.25	6.00	4.90	4.50	3.65	2.95	.....	.20	−.35
31	6.90	.....	4.90	.....	6.25	.....	4.50	3.75	.....	1.57	.....	−.35

LITTLE FORK RIVER.

GENERAL FEATURES OF AREA DRAINED.

Little Fork River, the largest tributary of Rainy River from the Minnesota side, rises in the central part of St. Louis County, a few miles south of Vermilion Lake, at an elevation of about 1,440 feet above sea level, and flows westward and then northwestward to its junction with Rainy River about 12 miles below International Falls. Fifteen miles below its source it receives Rice River from the southeast, and about 15 miles farther downstream it is joined by Sturgeon River, its principal tributary. Other tributaries are Valley, Cross, and Net Lake rivers and Beaver and Willow creeks. The total length of the river is about 160 miles and its drainage area is 1,900 square miles.

The river meanders through a narrow valley between wooded banks and throughout its length there are very few clearings. The region is flat and is deeply covered with blue till—a mixture of clay, sand, and gravel—which is underlain by crystalline rocks. Rock outcrops in a few places along the river. Altitudes in the basin range from 1,100 to 1,450 feet. The greater part of the area is too wet for cultivation without being drained and little drainage work has been done up to the present time.

A. LOG JAM ON LITTLE FORK RIVER, MINN.

Jam extended 4 miles upstream.

B. DAM ON ST. LOUIS RIVER 6 MILES BELOW SKIBO, MINN.

Typical logging dam on a northern Minnesota river.

The area supports a dense growth of heavy timber. Little of the land has been cleared. Little Fork River is used extensively for log driving, and although there are no logging dams on the main river the flow of the upper river is to a certain extent controlled by dams on one or two tributaries. (See Pl. IV, *B*.)

The mean annual rainfall ranges from about 30 inches in the upper end of the basin to about 25 inches near the mouth of the river. Of this amount 5½ inches falls as snow. From November to March the rivers are frozen except at heavy rapids and the ground is covered with several feet of snow, the spring melting of which causes a river rise of 15 feet or more. Winter thaws are unknown and groundwater is the principal source of supply for the streams. The flow is, therefore, very uniform during the winter, decreasing gradually till midwinter, when it is a minimum. The flatness of the topography and absence of lakes except on the extreme headwaters preclude the possibility of any large amount of storage except such as could be formed within the main channel of Little Fork River.

In order to determine the availability of Little Fork River for power development, a survey was made in 1911 from the big falls located in sec. 9, T. 62 N., R. 20 W., to the mouth of the river. From the data collected on this survey sheets have been prepared showing a profile of the water surface, a plan of the river, and the contours along the river bank. These sheets have been published separately, and may be had on application to the district engineer, United States Geological Survey, Old Capitol Building, St. Paul, Minn. No water power is developed in the basin at the present time.

LITTLE FORK RIVER AT LITTLE FORK, MINN

This station, which is located at the lower of the two highway bridges at Little Fork, Minn., in sec. 9, T. 68 N., R. 25 W., was established June 23, 1909, in connection with the general investigation of the water resources of Minnesota.

Beaver Brook, the nearest tributary, enters the river 1½ mile below the station.

Little Fork is used extensively for log driving during the spring and summer months and log jams frequently occur which cause backwater for some time. (See Pl. IV, *A*.) The river is frozen over at the station and observations are discontinued from November to April.

The datum of the staff gage has remained unchanged since the station was established.

Discharge measurements are made from the bridge at ordinary stages and by wading at extreme low stages.

Conditions at the station are favorable and the records of flow should be reliable.

Discharge measurements of Little Fork River at Little Fork, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 4	G. A. Gray	122	201	5.52	237
24	Robert Follansbee	122	184	5.41	190
Aug. 26	G. A. Gray	133	452	7.66	910
Sept. 30	do	132	445	7.50	824
1910.					
June. 21	C. R. Adams	136	214	5.30	180
July 22	Robert Follansbee	54	82.6	4.82	87.3

Daily gage height, in feet, of Little Fork River at Little Fork, Minn., for 1910.

[Theo. La Chapell, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	14.00	8.88	6.75	5.42	5.72	4.83	5.00	5.30
2	13.70	8.65	6.58	5.35	5.48	4.84	5.30	5.21
3	13.21	8.42	6.40	5.15	5.32	4.86	5.40	5.28
4	12.69	8.16	6.40	4.92	5.28	4.75	5.45	5.30
5	12.64	7.95	6.45	5.02	5.28	4.40	5.40	5.40
6	12.66	7.70	6.40	4.95	5.20	4.70	5.40	5.50
7	12.45	7.49	6.45	4.80	5.05	4.75	5.30	5.50
8	12.00	7.35	6.60	4.78	5.00	4.84	5.30	5.50
9	11.50	7.25	6.55	4.72	5.00	4.80	5.25	5.50
10	11.00	7.01	6.35	4.75	4.95	4.85	5.18	5.50
11	10.58	6.79	6.24	4.96	4.85	4.85	5.10	5.50
12	10.05	6.80	6.05	5.00	4.95	4.86	5.10	5.50
13	9.68	6.69	6.00	5.00	4.95	4.90	5.18	5.50
14	9.35	6.58	5.95	4.88	4.90	4.88	5.15	5.50
15	9.10	6.50	5.75	5.02	4.98	4.80	5.10	5.50
16	9.60	6.40	5.62	5.02	4.95	4.71	5.05	.....
17	10.80	6.35	5.58	5.15	4.92	4.70	5.00	.....
18	14.95	6.40	5.54	5.20	4.95	4.80	5.00	.....
19	15.60	6.39	5.46	4.90	4.98	4.78	5.38	.....
20	15.25	6.38	5.38	4.90	4.98	4.76	5.20	.....
21	15.00	6.62	5.28	4.88	4.96	4.90	5.22	.....
22	14.32	6.78	5.21	5.10	4.95	4.96	5.20	.....
23	12.95	7.00	5.16	5.15	4.93	4.89	5.19	.....
24	11.92	7.10	5.10	5.02	4.95	4.80	5.20	.....
25	11.20	7.15	5.04	5.02	4.95	4.80	5.30	.....
26	10.75	7.00	5.00	5.08	4.95	4.80	5.30	.....
27	10.25	7.00	4.96	5.08	4.95	4.80	5.30	.....
28	9.90	7.00	4.96	5.85	4.86	4.80	5.30	.....
29	9.55	7.10	5.60	6.10	4.85	4.86	5.30	.....
30	9.10	7.06	5.70	6.05	4.83	5.00	5.30	.....
31	.....	6.82	.....	5.85	4.83	.....	5.30	.....

NOTE.—Ice present from Jan. to Mar. 31, and from Nov. 16 to Dec. 31.

Daily discharge, in second-feet, of Little Fork River at Little Fork, Minn., for 1909–10.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1909.							1909.						
1	.....	240	247	1,030	708	1,360	16	.....	160	3,980	247	598	.....
2	.....	237	224	900	634	1,240	17	.....	156	3,650	242	630	.....
3	.....	224	208	757	614	1,170	18	.....	164	3,120	228	687	.....
4	.....	208	215	667	518	1,090	19	.....	189	2,070	237	698	.....
5	.....	199	237	940	463	980	20	.....	193	1,860	247	778	.....
6	.....	193	291	512	393	932	21	.....	193	1,260	268	1,230	.....
7	.....	184	304	440	371	864	22	.....	197	1,080	288	2,010	.....
8	.....	184	502	405	344	802	23	377	193	932	366	2,340	.....
9	.....	178	852	371	347	621	24	360	184	908	382	2,700	.....
10	.....	166	896	330	377	680	25	333	252	908	640	2,700	.....
11	.....	148	1,650	291	422	750	26	307	294	868	920	2,560	.....
12	.....	137	3,760	286	472	694	27	296	307	852	988	2,410	.....
13	.....	141	4,120	266	487	598	28	281	347	868	988	2,180	.....
14	.....	166	4,380	266	487	.....	29	268	358	1,050	920	1,860	.....
15	.....	160	4,240	254	518	.....	30	261	328	1,080	802	1,600	.....
							31	.....	286	1,140	.....	1,490	.....

Daily discharge, in second-feet, of Little Fork River at Little Fork, Minn., for 1909–10— Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1910.								
1	.....	1,390	565	201	271	91	119	176
2	.....	1,290	512	186	215	92	176	158
3	.....	1,190	457	146	180	96	197	172
4	.....	1,080	457	105	172	79	208	176
5	.....	1,000	472	123	172	40	197	197
6	.....	900	457	110	156	72	197	.....
7	.....	816	472	86	128	79	176	.....
8	.....	768	518	83	119	92	176	.....
9	.....	732	502	75	119	86	166	.....
10	.....	650	442	79	110	94	152	.....
11	2,200	578	411	112	94	94	137	.....
12	1,940	581	358	119	110	96	137	.....
13	1,750	546	344	119	110	102	152	.....
14	1,600	512	330	99	102	99	146	.....
15	1,490	487	278	123	116	86	137	.....
16	1,720	457	247	123	110	73	128	.....
17	2,310	442	237	146	105	72	119	.....
18	4,580	457	228	156	110	86	119	.....
19	5,000	454	210	102	116	83	193	.....
20	4,770	451	193	102	116	80	156	.....
21	4,610	524	172	99	112	102	160	.....
22	4,200	575	158	137	110	112	156	.....
23	3,430	647	148	146	107	100	154	.....
24	2,870	680	137	123	110	86	156	.....
25	2,510	698	126	123	110	86	176	.....
26	2,280	647	119	133	110	86	176	.....
27	2,040	647	112	133	110	86	176	.....
28	1,860	647	112	304	96	86	176	.....
29	1,690	680	242	371	94	96	176	.....
30	1,490	667	266	358	91	119	176	.....
31	.....	588	.....	304	91	.....	176	.....

NOTE.—Discharges computed from a rating curve well defined below 1,000 second-feet.

Monthly discharge of Little Fork River at Little Fork, Minn., for 1909–10.

[Drainage area, 1,720 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
June 23–30	377	261	310	0.180	0.05	A.
July	358	137	212	.123	.14	A.
August	4,380	208	1,540	.895	1.03	C.
September	1,030	228	516	.300	.33	B.
October	2,700	344	1,080	.628	.72	B.
Nov. 1–13	1,360	598	680	.395	.19	B.
1910.						
Apr. 11–30	.....	1,490	2,720	1.58	1.17	B.
May	1,390	442	703	.409	.47	A.
June	565	112	309	.180	.20	A.
July	371	75	149	.087	.10	A.
August	271	91	125	.073	.08	A.
September	119	40	88.4	.051	.06	A.
October	208	119	163	.095	.11	A.
November	.....	.....	160	.093	.10	B.

NOTE.—Mean discharge, Mar. 6 to 30, estimated at 157 second-feet.

BIG FORK RIVER.

GENERAL FEATURES OF AREA DRAINED.

Big Fork River, the second largest tributary of Rainy River from the Minnesota side, rises in Jessie Lake in T. 147 N., R. 25 W., in Itasca County, at an elevation of about 1,320 feet above sea level. It flows into Bowstring Lake, thence north into Wabatawangang Lake and thence east and north into Rainy River near Laurel. Its chief tributaries are Caldwell Brook, Sturgeon River, Deer Lake outlet, and Rice River. The entire length of river is about 160 miles.

The following drainage areas have been measured in the basin:

Drainage areas in basin of Big Fork River.

	Square miles.
Above Lake Wabatawangang	259
Above Big Falls	1,320
Above mouth	1,840

The entire basin is covered with a sheet of blue till. In a large part of the area the till is covered with deposits of lacustrine clay from the glacial Lake Agassiz. So thick is the drift that rock outcrops are not found except in a few places along the river.

Underlying the glacial deposits are crystalline schists and gneisses and greenstones. Some outcrops of Cretaceous rocks are also found. The big falls where the river descends 30 feet in a few hundred yards are caused by an outcrop of Archean schist.

The region is very flat and so poorly drained that, except in a comparatively narrow strip along Big Fork River, the area is swampy. There is very little cleared land in the basin, as settlers are few, and the entire area is heavily forested. Altitudes range from 1,080 to 1,325 feet above sea level. There are practically no lakes in the basin below the outlet of Lake Wabatawangang, but above that point about 15 per cent of the area is water surface.

Owing to a lack of records within the basin the mean annual rainfall is not precisely known, but records at stations farther south indicate that the average precipitation is about 26 inches; of this amount 4½ inches occurs as snow.

The winters are severe. The river flows under ice several feet thick and the ground is covered with several feet of snow. There are no winter thaws and the sources of supply are the ground water and the lakes on the headwaters. The flow is very uniform, decreasing gradually till midwinter, when it is a minimum.

The chain of lakes on the headwaters of the Big Fork afford a possible storage reservoir, and as the drainage area at their outlet is between 400 and 500 square miles, the control of the flow above that point would considerably increase the low-water flow. Aside from the headwaters, there are no lakes in the basin. The topography

is too flat to admit of the presence of reservoir sites, and except at Big Falls there is little concentrated fall. No water powers are developed in the basin.

Big Fork River is used extensively for log driving, and at different points, notably the Big Falls, jams occur, which cause backwater for considerable periods. There are no logging dams to control the flow.

Although the records of the only gaging station maintained in the basin, namely at Big Falls, extend back only to 1909, it is probable that the flow of 1910 was the lowest in many years, owing to the very low rainfall.

In order to determine the availability of Big Fork River for power development, a survey was made in 1912 from Stanley to the mouth. From the data collected on this survey sheets have been prepared showing a profile of the water surface, a plan of the river, and the contours along the bank. These sheets have been published separately, and may be obtained by applying to the district engineer, United States Geological Survey, Old Capitol Building, St. Paul, Minn.

BIG FORK RIVER AT BIG FALLS, MINN.

This station, which is located on the Minnesota & International Railroad bridge crossing Big Fork River from Big Falls to Grand Falls, was established August 27, 1909, for the purpose of obtaining data concerning the power available at the falls, a short distance below the station.

The nearest important tributary is Sturgeon River, which enters Big Fork about 3 miles below Big Falls.

Like most of the streams in northern Minnesota, Big Fork is used in the spring for log driving, and the log jams that frequently occur may cause temporary backwater at the gage and render it impossible to make discharge measurements. However, conditions at the head of the falls (which is the control point for the gage section) are such that the logs simply float on the water surface for the most part and cause little or no backwater. This is shown by a comparison of gage heights with the Little Fork station, which is free from log jams. The two stations show the same general fluctuations of water surface, which would not be the case were one of them seriously affected by backwater. The stream is icebound from December to April.

The bridge from which the discharge measurements are made is oblique to the current. The datum of the staff gage, which is located at the measuring section, has remained unchanged since the gage was installed. Owing to the possibility of slight backwater from log jams and to the uncertainty in the lower part of the rating curve, records of flow at this station can be considered only fair.

Discharge measurements of Big Fork River at Big Falls, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 27	G. A. Gray	266	1,510	4.66	960
Oct. 1	do	246	1,210	4.01	535
1910.					
July 22	Robert Follansbee	.....	.....	2.78	*a* 65

a Estimated from rough measurement.

Daily gage height, in feet, of Big Fork River at Big Falls, Minn., for 1910.

[Mark St. Louis, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	6.90	6.32	4.76	3.49	2.95	2.69	3.26	3.52
2	7.15	6.24	4.72	3.41	2.90	2.65	3.29	3.48
3	7.25	5.98	4.65	3.36	2.86	2.80	3.35	3.39
4	7.20	6.35	4.52	3.34	2.91	2.82	3.31	3.32
5	6.80	6.10	4.68	3.28	2.86	2.92	3.24	3.29
6	6.82	6.05	4.82	3.38	2.80	2.96	3.20	3.22
7	6.95	6.12	4.79	3.31	2.75	2.91	3.16	3.16
8	6.88	6.02	4.68	3.26	2.70	2.86	3.19	3.12
9	6.86	5.92	4.59	3.20	2.69	2.85	3.21	3.04
10	6.60	5.85	4.52	3.16	2.65	2.94	3.25	2.92
11	6.42	5.60	4.41	3.42	2.66	2.95	3.28	2.89
12	6.25	5.32	4.39	3.35	2.80	2.91	3.35	2.81
13	6.18	5.08	4.56	3.28	2.86	2.89	3.42	.....
14	6.08	4.86	4.51	3.22	2.82	2.98	3.50	.....
15	6.12	4.72	4.41	3.11	2.79	2.95	3.62	.....
16	6.30	5.02	4.35	3.00	2.76	2.92	3.61	.....
17	7.45	5.38	4.30	2.94	2.74	2.91	3.59	.....
18	8.22	5.56	4.26	2.86	2.70	2.98	3.55	.....
19	8.68	5.62	4.21	2.80	2.66	2.94	3.65	.....
20	8.62	5.48	4.11	2.75	2.64	2.91	3.78	.....
21	8.58	5.35	3.96	2.75	2.86	2.89	3.81	.....
22	8.19	5.28	4.15	2.74	2.81	2.96	3.79	.....
23	7.60	5.42	4.00	.....	2.74	3.00	3.75	.....
24	7.32	5.34	3.89	2.94	2.68	2.98	3.72	.....
25	7.00	5.26	3.81	2.95	2.79	2.94	3.69	.....
26	6.58	5.20	3.76	2.90	2.71	2.96	3.69	.....
27	6.40	5.15	3.71	2.85	2.62	3.01	3.76	.....
28	6.28	5.05	3.64	2.96	2.80	3.11	3.75	.....
29	6.15	4.94	3.60	2.96	2.80	3.19	3.71	.....
30	6.28	4.88	3.54	2.91	2.76	3.25	3.69	.....
31	.....	4.81	.....	3.00	2.71	.....	3.61	.....

NOTE.—Ice present from Jan. 1 to Mar. 31 and from Nov. 13 to Dec. 31.

Daily discharge, in second-feet, of Big Fork River at Big Falls, Minn., for 1909–10.

Day.	Aug.	Sept.	Oct.	Nov.	Day.	Aug.	Sept.	Oct.	Nov.
1909.					1909.				
1	.....	812	536	1,140	17	.....	395	910	.....
2	.....	731	492	1,070	18	.....	375	910	.....
3	.....	628	470	1,000	19	.....	430	948	.....
4	.....	574	465	955	20	.....	470	1,100	.....
5	.....	530	460	918	21	.....	514	1,340	.....
6	.....	481	460	854	22	.....	616	1,820	.....
7	.....	465	445	805	23	.....	738	2,140	.....
8	.....	415	445	770	24	.....	784	2,140	.....
9	.....	400	470	770	25	.....	777	2,100	.....
10	.....	375	552	738	26	.....	718	1,960	.....
11	.....	366	679	712	27	978	653	1,780	.....
12	.....	348	784	628	28	1,040	604	1,600	.....
13	.....	360	840	580	29	1,110	580	1,430	.....
14	.....	360	840	552	30	1,060	552	1,310	.....
15	.....	375	840	525	31	948	.....	1,210	.....
16	.....	385	875	.....					

Daily discharge, in second-feet, of Big Fork River at Big Falls, Minn., for 1909–10—Con.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1910.								
1	2,960	2,390	1,030	281	108	48	196	293
2	3,200	2,320	1,000	249	95	40	206	277
3	3,300	2,070	948	231	86	72	227	242
4	3,260	2,420	854	224	98	77	214	217
5	2,860	2,180	970	203	86	100	189	206
6	2,880	2,140	1,080	238	72	110	175	182
7	3,000	2,200	1,050	214	61	98	163	163
8	2,940	2,110	970	196	50	86	172	151
9	2,920	2,020	903	175	48	84	179	130
10	2,660	1,960	854	163	40	105	192	100
11	2,490	1,730	777	253	42	108	203	94
12	2,330	1,490	764	228	72	98	227	74
13	2,260	1,280	882	203	86	93	253	.....
14	2,170	1,110	847	182	77	115	285	.....
15	2,200	1,000	777	148	70	108	334	.....
16	2,380	1,240	738	120	63	100	329	.....
17	3,500	1,540	705	105	59	98	321	.....
18	4,310	1,690	779	86	50	115	305	.....
19	4,790	1,750	646	72	42	105	347	.....
20	4,730	1,620	586	61	38	98	410	.....
21	4,690	1,510	503	61	86	93	425	.....
22	4,280	1,450	610	59	74	110	415	.....
23	3,660	1,570	525	82	59	120	395	.....
24	3,380	1,500	465	105	46	115	380	.....
25	3,060	1,440	425	108	70	105	366	.....
26	2,640	1,380	400	95	52	110	366	.....
27	2,470	1,340	375	84	34	122	400	.....
28	2,360	1,260	343	110	72	148	395	.....
29	2,230	1,170	325	110	72	172	375	.....
30	2,360	1,120	301	98	63	192	366	.....
31	.....	1,070	.....	120	52	.....	329	.....

NOTE.—Discharge based on a rating curve not well defined.

Monthly discharge of Big Fork River at Big Falls, Minn., for 1909–10.

[Drainage area, 1,320 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
ugust 27–31	1,110	948	1,030	0.780	0.15	B.
eptember	812	348	527	.399	.45	B.
ctober	2,140	445	1,040	.788	.91	B.
ovember	1,140	.....	660	.500	.56	C.
1910.						
pril	4,790	2,170	3,080	2.33	2.60	D.
ay	2,420	1,000	1,650	1.25	1.44	C.
ne	1,080	301	714	.541	.60	C.
ly	281	59	150	.114	.13	C.
ugust	108	34	65.3	.049	.06	C.
ptember	192	40	105	.080	.09	C.
tober	425	163	295	.223	.26	B.
ovember 1–12	293	74	177	.134	.06	C.

NOTE.—Mean for Nov. 16 to 30, 1909, estimated at 520 second-feet.

UPPER MISSISSIPPI RIVER DRAINAGE BASIN.

GENERAL FEATURES.

Mississippi River drains the greater part of the territory of the United States lying between the Alleghenies and the Rockies. Its basin, irregular in shape, occupies the central part of the United States, and is best described as an oblong, with the major axis, 1,700 miles in length, running southeastward from the northwestern part of Montana, through North Dakota, Nebraska, Missouri, and Tennessee, into the northwestern corner of Alabama. On each side of this line the basin spreads out from 300 to 500 miles, and on the east is a large protuberance from the general outline extending to the Alleghenies. The basin comprises about 1,240,000 square miles, and includes wholly or in part 30 States, besides a small area in the Dominion of Canada. Of the total area, about 527,000 square miles drain to the Missouri, about 171,500 square miles to the upper Mississippi above the mouth of the Missouri, and about 204,000 square miles to the Ohio. The mean annual flow of the Missouri is about 100,000 second-feet; of the upper Mississippi, about 125,000 second-feet; of the Ohio, about 300,000 second-feet.

Immediately beneath the covering of drift at the sources of the Mississippi lie the oldest rocks known to the geologist. Its mouth is surrounded by the soft marshes of its own delta now forming. Between these two extremes rocks of all geologic ages are represented.

All varieties of topography are likewise exhibited in the drainage basin, mountain and prairie, arid plain, and alluvial bottom covered with vegetation, being fully represented; but the greater part of its broad extent is very uniform in contour.

For convenience in publication of reports the basin of Mississippi River has been divided into the upper Mississippi, Missouri River, lower Mississippi, and Ohio drainage basins. The upper Mississippi Basin, as considered in this discussion, is that portion lying above the mouth of the Missouri. The upper Mississippi Basin therefore occupies the north-central part of the United States, including Minnesota, Wisconsin, Iowa, Illinois, Indiana, Missouri, and a few square miles in South Dakota and the northern peninsula of Michigan. The sources of this branch of the great river are almost exactly in the center of the continent on an east and west line.

The Mississippi rises, not in Lake Itasca, so long considered the source, but in a smaller lake called Hernando de Soto, which is situated in the northeastern part of Becker County, Minn., and which drains into Lake Itasca through Nicollet Creek. From these lakes to the mouth of Crow Wing River it flows almost in a circle, as at this point it is only 75 miles from its sources, while the distance following the river is 350 miles. Leaving the lakes its course is northward, but below the junction with the Crow Wing it turns to the south

and continues in this direction until it finally reaches the Gulf of Mexico.

The total length of the river is about 2,555 miles; from the source to the mouth of the Ohio is about 1,500 miles.[1]

The important tributaries of the upper Mississippi, beginning at the source and following down the west bank, are Leech Lake, Willow, Pine, Crow Wing, Sauk, Crow, Minnesota, Cannon, Zumbro, Root, Turkey, Wapsipinicon, Iowa, Des Moines, and Missouri rivers; on the east bank are Prairie, Elk, Rum, St. Croix, Chippewa, Black, La Crosse, Wisconsin, Rock, Illinois, Kaskaskia, Big Muddy, and Ohio rivers.

From Lake Hernando de Soto to the Falls of St. Anthony the river flows almost exclusively through a drift-covered region. Down to Pokegama Falls it occupies a valley which is in some places narrow, in others broad and savanna-like, with many rapids in the narrower and with gentle or sluggish currents in the broader portions. In this part of its course it drains a number of lakes, among which Bemidji, Cass, Winnibigoshish, and Leech are the most important. The first rock in place is at Pokegama Falls, and thence to the mouth of Crow Wing River, which enters from the west, the average width of the stream is 300 feet, the valley is less winding, and the current is good, with many rapids of small extent.

Below the mouth of the Crow Wing the river flows in a general southeasterly direction for about 475 miles. Within this stretch are several rapids—the chief being Little Falls and Sauk Rapids—and many timbered islands. The banks are abrupt, of clay or sandy loam, and lead to meadows that stand 60 feet above the river. At the falls of St. Anthony the river pitches down a vertical fall and rapids amounting to 80 feet in half a mile, and in so doing leaves the prairie and clay banks for a channel that lies between rocky bluffs of limestone and sandstone, which continue for many miles, gradually increasing to a height of 500 feet as the bed sinks below the general prairie level. The sides of the bluff are not vertical bare surfaces of rock, but are composed of easily eroded stone and drift, which form well-wooded or grassy slopes. It is believed by geologists that the gorge from the mouth of the Minnesota River to St. Anthony Falls was caused by the gradual wearing away of the falls, which were originally at the mouth of the Minnesota.

Minnesota River enters the Mississippi about 16 miles below St. Anthony Falls, and below its mouth the width of the main stream averages 1,000 feet. From this point to the mouth of the Missouri it

[1] The Twenty-second Annual Report of the United States Geological Survey, pt. 4, p. 210, contains a detailed description of the Mississippi from the sources to St. Paul, taken from the Reports of the Chief of Engineers, U. S. Army. The hydrographic investigations of the United States Engineer Corps on the upper Mississippi extend over a period of 32 years, from 1866 to 1898, and form, according to the Report of the Chief of Engineers for 1897, "the largest continuous record over large drainage areas that has been made in the United States."

is a broad, placid stream, containing innumerable islands, the entire width of the valley averaging 1 mile. In many places, especially where tributaries enter, fertile flats lie between the river and the bluffs. Fifty-five miles below the mouth of the Minnesota is Lake Pepin, an expansion of the river apparently caused by the immense quantities of sand brought down by the Chippewa. At two places exceptions occur to the otherwise placid character of the river. At Rock Island, Ill., 384 miles from St. Paul, there are rapids by which the river falls about 20 feet in 12 miles; and at Keokuk, Iowa, 509 miles from St. Paul, is the foot of the Des Moines Rapids, where in a distance of 11 miles the river falls about 22 feet.

The following table, compiled chiefly from the charts of the Mississippi River Commission, shows the elevations at different points of the upper river. (The distances are measured along the river channel.)

Elevations and distances along Mississippi River.

	Distance below Lake Itasca.	Elevation.
	Miles.	*Feet.*
Lake Itasca	0	1,472
Lake Bemidji, above dam	42	1,340
Winnibigoshish Lake, above dam	85	1,304
Leech Lake River	117	1,285
Ball Club River	120	1,282
Vermilion River	142	1,278
Rice Creek	149	1,277
Above Pokegama dam	158	1,277
Above Grand Rapids dam	161	1,268
Prairie River	164	1,246
Swan River	203	1,229
Dinky Rapids	215	1,225
Oxbow Rapids	226	1,217
Sandy River	234	1,212
Willow River	262	1,203
Aitkin	282	1,194
Indian Lake outlet	309	1,189
Pine River	313	1,180
Above Brainerd dam	334	1,172
Buffalo Creek	340	1,152
Crow Wing River	347	1,149
Pipe Island	358	1,138
Above Little Falls dam	372	1,102
Pike Creek	374	1,078
Two Rivers	383	1,032
Above Sartell dam	404	1,014
Sauk River	407	992
Above St. Cloud dam	410	978
Clearwater River	422	936
Silver Creek	430	929
Monticello	439	897
Elk River	450	859
Crow River	456	843
Rum River	464	827
Above St. Anthony Falls, upper dam	482	796
Below St. Anthony Falls, lower dam	482	728
Below United States Lock and Dam No. 2	485	702
Minnesota River	490	692
St. Paul	496	689
Lake St. Croix	522	673
Red Wing	542	668
Frontenac	553	667
Chippewa River	570	664
Wabasha	574	663
Whitewater River	590	652
Winona	608	643
Root River	638	628
State line	658	615

The headwaters of the main stream and its tributaries which lie in Wisconsin and in Minnesota north of a line drawn diagonally through Douglas, Stevens, Meeker, McLeod, Sibley, Lesueur, Rice, and Dakota counties are in a region that was originally forested. Most of this area has been cut over extensively, though a comparatively small proportion has been cleared, except in the southern part of the area, where agriculture is making rapid progress. The remainder of the drainage area is prairie land.

The entire basin, at least as far south as the southern boundary of Minnesota, is covered with glacial drift of varying thickness. The tributaries north of St. Anthony Falls at Minneapolis flow over the drift without uncovering the underlying rock, while those farther south have worn deep valleys through both the drift and the rock. Along these bluffs are found many springs.

Rainfall records have been kept in the upper basin for many years, and from them the following data have been compiled:

Mean annual rainfall at points in upper Mississippi basin.

	Inches.
Lake Winnibigoshish, 1888–1909	26.5
Leech Lake, 1888–1909	27.4
Pokegama Falls, 1888–1909	27.9
Sandy Lake, 1893–1909	27.1
Pine River dam, 1888–1909	28.2
Park Rapids, 1885–1909	26.7
Long Prairie, 1893–1909	26.1
Collegeville, 1893–1909	23.3
New London, 1897–1909	23.8
St. Paul, 1837–1909	27.8
Red Wing, 1886–1909	30.2
Wabasha, 1893–1909	30.5
Winona, 1886–1909	30.5

The winters in Wisconsin, Minnesota, and Iowa are severe; snowfall is heavy throughout the greater part of this area, the snow lasts for considerable periods, ice forms to thickness of 1 to 2 feet, and lasts for three to four months. In other parts of the drainage basin the winters are milder.

According to some authorities the basin of the upper Mississippi contains from 5,000 to 6,000 lakes, nearly all of which are near the sources of the main river and its northern tributaries. In addition, there are vast swamp areas in this region, so that there is great natural storage for steadying the flow of the river. Practically none of this swamp land has been drained at the present time. By building comparatively low dams it will be possible to create reservoirs on many of the lakes.

The river is navigable as far up as St. Anthony Falls, and above that there are navigable stretches from 10 miles below Brainerd to

Grand Rapids; from Cohasset to Pokegama Lake and Ball Club; on Winnibigoshish and Cass lakes; and on Lake Bemidji, Lake Irving, and Lake Plantagenet.

The United States Engineer Corps has built six reservoirs on the Mississippi headwaters for the purpose of aiding navigation during the low-water open season. These reservoirs have the following storage capacity:

	Feet head.	Cubic feet.
Winnibigoshish	14	44,000,000,000
Leech Lake	5.7	33,000,000,000
Pokegama Lake	7.5	5,300,000,000
Sandy Lake	9.4	3,200,000,000
Pine River dam	16.2	7,700,000,000
Gull Lake	3	2,700,000,000

Although the reservoirs are operated primarily in the interest of navigation, water power and flood control are also benefited. The operation during the winter, or nonnavigation season, is based on the necessity for having 39,000,000,000 cubic feet empty storage capacity on April 1 to take care of the spring high water. Thus if the preceding year has been very dry and the storage has been nearly exhausted, the reservoirs allow only the normal minimum winter flow (as determined previous to building the reservoirs) to pass down the river. If the preceding navigation season has not drawn heavily on the reservoirs, the winter flow is increased by a sufficient amount to make possible the required empty storage capacity April 1.

That there are valuable power sites on Mississippi River is shown by the facts that plants at Bemidji, Grand Rapids, Brainerd, Little Falls, Sartell, St. Cloud, and Minneapolis develop about 80,000 horsepower. Besides these there are several other points where a heavy fall occurs within a comparatively short distance, especially between Minneapolis and Brainerd. The United States Government is building a 30-foot dam on the Mississippi just above the mouth of the Minnesota, which will develop a large amount of power, and a dam is being built at Keokuk which will develop one of the largest powers in the country.

The river is used extensively for logging as far down as Minneapolis, and log jams frequently occur on the various bars that cause more or less backwater for short periods.

The quality of the water in the portion of the Mississippi basin lying in Minnesota has been investigated by the United States Geological Survey, and the results published in Water-Supply Paper 193, entitled "The quality of surface waters in Minnesota."

Records of discharge of Mississippi River have been kept for many years. Since 1892 the year of least flow has been 1895 and that of greatest flow 1906. The greatest flood flow, however, occurred in 1897.

MISSISSIPPI RIVER ABOVE SANDY RIVER, MINN.

This station, which was established September 1, 1895, is located a short distance above the mouth of Sandy River, near Libby post office, in Aitkin County, and is maintained by the United States Engineer Corps.

The discharge represents chiefly the water from the Government reservoirs at Winnibigoshish, Leech, and Pokegama lakes, as the streams between the lower reservoir and the gaging stations are relatively small. The largest are Prairie and Swan rivers, which drain 501 and 340 square miles, respectively. The flow from the other two reservoirs in the system—Sandy Lake and Pine River—is shown by the tables on pages 136–148 and 149–159. The sum of the discharge at the three stations represents the flow of the upper Mississippi as affected by the reservoir systems.

Frequent discharge measurements are made throughout the year by an employee stationed at Sandy Lake dam. The daily discharge is computed almost directly from discharge measurements.

The daily discharge and monthly mean discharge for this station have been compiled from unpublished records in the United States engineer office at St. Paul. The run-off per square mile, depth in inches on drainage area, and total run-off in millions of cubic feet have been computed by the Geological Survey.

Daily discharge, in second-feet, of Mississippi River above Sandy River, Minn., for 1895–1910.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1895.					1895.				
1	2,192	2,322	2,128	1,216	16	2,206	2,059	2,087	668
2	2,193	2,375	1,866	1,161	17	2,207	1,870	2,047	653
3	2,194	2,256	1,908	1,106	18	2,208	1,988	2,007	638
4	2,195	2,281	1,951	1,070	19	2,209	2,008	1,967	636
5	2,196	2,240	1,993	1,034	20	2,210	2,009	1,880	634
6	2,197	2,295	1,974	999	21	2,211	2,011	1,794	633
7	2,198	2,350	1,954	963	22	2,212	2,183	1,707	620
8	2,199	2,429	1,995	923	23	2,213	1,982	1,620	606
9	2,200	2,193	2,036	883	24	2,213	2,012	1,533	592
10	2,201	2,177	2,077	843	25	2,213	2,042	1,447	579
11	2,201	2,240	2,118	804	26	2,214	1,911	1,360	565
12	2,202	2,293	2,159	768	27	2,214	1,977	1,333	552
13	2,203	2,218	2,200	733	28	2,215	2,043	1,306	538
14	2,204	2,142	2,229	698	29	2,251	2,109	1,278	518
15	2,205	2,248	2,258	683	30	2,286	2,176	1,251	498
					31		2,163		477

Daily discharge, in second-feet, of Mississippi River above Sandy River, Minn., for 1895–1910—Continued.

Date.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1896.												
1	430	438	230	600	5,011	.....	2,065	1,687	1,965	2,120	3,133	1,055
2	400	435	235	620	5,376	.....	2,120	1,754	1,985	2,059	3,181	1,009
3	380	432	230	610	.....	.....	2,180	1,821	2,080	2,103	3,230	963
4	400	429	225	585	.....	.....	2,210	1,890	2,175	2,148	3,245	918
5	450	426	210	565	.....	.....	2,190	1,957	2,270	2,193	3,235	895
6	480	423	185	545	.....	3,840	2,160	2,024	2,365	2,238	3,200	874
7	420	419	180	516	.....	3,763	2,077	2,091	2,323	2,282	2,600	853
8	380	416	165	530	.....	3,687	1,994	2,157	2,348	2,327	2,030	832
9	410	413	165	535	.....	3,611	1,911	2,223	2,367	2,372	1,900	810
10	410	410	175	555	.....	3,534	1,829	2,289	2,450	2,417	1,785	808
11	410	407	183	610	.....	3,458	1,746	2,357	2,400	2,462	1,755	806
12	410	404	200	950	.....	3,382	1,663	2,423	2,350	2,507	1,745	804
13	465	392	230	1,750	.....	3,305	1,580	2,489	2,300	2,551	1,740	803
14	465	380	258	2,150	.....	3,229	1,544	2,555	2,250	2,596	1,740	801
15	445	368	290	2,425	.....	3,153	1,509	2,558	2,200	2,641	1,740	799
16	440	460	330	2,550	.....	3,077	1,473	2,562	2,150	2,686	1,740	807
17	460	445	348	2,655	.....	3,000	1,438	2,565	2,100	2,731	1,694	816
18	460	415	350	2,750	.....	2,924	1,402	2,569	2,050	2,775	1,648	824
19	420	270	350	2,826	.....	2,848	1,367	2,572	2,100	2,820	1,603	833
20	470	180	360	2,925	.....	2,800	1,331	2,575	2,150	2,865	1,557	841
21	520	130	365	2,820	.....	2,750	1,291	2,531	2,200	2,910	1,511	850
22	520	115	365	2,400	.....	2,860	1,251	2,487	2,250	2,955	1,466	858
23	445	125	375	2,350	.....	2,925	1,210	2,443	2,300	3,000	1,420	867
24	490	130	385	2,675	.....	2,675	1,170	2,400	2,350	3,000	1,374	901
25	530	145	405	2,960	.....	2,375	1,172	2,356	2,400	3,000	1,329	935
26	520	160	422	3,250	.....	1,814	1,175	2,312	2,420	3,000	1,283	969
27	520	175	439	3,547	.....	1,920	1,210	2,239	2,360	3,000	1,237	1,002
28	520	200	455	3,913	.....	1,975	1,300	2,166	2,300	3,000	1,192	1,036
29	495	225	484	4,279	.....	2,025	1,390	2,094	2,240	3,000	1,146	1,070
30	425	.....	513	4,645	.....	2,000	1,485	2,021	2,180	3,043	1,100	1,104
31	438	.....	541	.....	.....	.....	1,590	1,948	.....	3,085	.....	1,138
1897.												
1	1,010	900	690	1,417	3,062	2,754	2,999	4,685	2,174	2,756	.....	2,958
2	906	860	694	1,590	3,023	2,680	2,758	4,464	2,199	2,794	.....	2,971
3	802	851	681	1,764	2,983	2,605	3,714	4,242	2,224	2,832	.....	2,889
4	699	843	668	2,104	2,944	2,531	4,671	4,020	2,333	2,869	.....	2,846
5	595	834	654	2,444	2,904	2,457	5,627	3,798	2,443	2,907	.....	2,742
6	590	833	641	2,784	3,174	2,382	5,793	3,576	2,552	2,607	.....	2,733
7	585	831	633	3,124	3,444	2,308	5,960	3,468	2,661	2,307	.....	2,621
8	580	830	625	3,464	3,582	2,535	6,126	3,359	2,736	2,007	.....	2,625
9	585	828	616	3,804	3,719	2,762	6,292	3,251	2,811	2,105	.....	2,612
10	590	769	638	4,143	3,857	2,989	6,459	3,142	2,886	2,203	.....	2,526
11	594	710	658	4,483	3,771	3,210	6,625	3,116	2,961	2,301	.....	2,405
12	599	651	662	4,823	3,686	3,432	6,791	3,090	2,935	2,256	.....	2,345
13	603	662	667	5,163	3,600	3,653	6,957	3,064	2,908	2,210	.....	2,272
14	606	674	671	5,503	3,486	3,591	7,124	3,069	2,882	2,165	.....	2,280
15	609	685	675	5,843	3,371	3,529	7,290	3,073	2,878	2,119	.....	2,190
16	702	696	679	5,443	3,256	3,467	7,456	3,078	2,874	2,155	.....	2,117
17	796	693	686	5,040	3,141	3,405	7,623	3,082	2,870	2,192	.....	2,018
18	890	690	692	4,863	2,914	3,561	7,789	3,051	2,866	2,228	.....	1,872
19	905	687	699	4,683	2,686	3,717	7,567	3,021	2,862	2,264	.....	1,576
20	920	688	706	4,503	2,459	3,873	7,346	2,990	2,859	2,420	.....	1,339
21	922	689	736	4,323	2,232	3,828	7,124	2,903	2,870	2,576	.....	1,473
22	924	690	765	4,143	2,176	3,739	6,902	2,817	2,881	2,732	.....	1,659
23	926	691	800	3,962	2,119	3,763	6,681	2,730	2,893	2,811	.....	1,746
24	928	692	836	3,782	2,063	3,695	6,459	2,643	2,902	2,890	.....	1,785
25	930	689	871	3,602	2,007	3,650	6,237	2,557	2,915	2,969	.....	1,828
26	893	685	906	3,422	1,951	3,517	6,015	2,470	2,789	3,048	.....	1,832
27	900	681	947	3,342	1,894	3,384	5,794	2,383	2,662	3,030	.....	1,815
28	908	685	987	3,262	1,838	3,252	5,572	2,296	2,536	3,011	.....	1,802
29	915	.....	1,028	3,182	2,168	3,119	5,350	2,010	2,609	2,993	.....	1,794
30	923	.....	1,069	3,102	2,498	2,878	5,129	2,123	2,683	3,060	.....	1,768
31	930	.....	.....	.....	2,828	.....	4,907	2,148	.....	3,127	.....	1,746
1898.												
1	1,716	1,257	1,289	1,472	1,514	2,377	3,481	3,278	3,156	2,971	3,597	2,042
2	1,693	1,207	1,289	1,467	1,608	2,344	3,558	3,278	3,276	2,976	3,551	2,037
3	1,670	1,207	1,289	1,472	1,737	2,592	3,580	3,225	3,446	3,025	3,538	2,037
4	1,647	1,217	1,289	1,502	1,876	3,584	3,851	3,198	3,557	3,038	3,591	2,037
5	1,577	1,227	1,300	1,513	1,725	4,261	3,851	3,104	3,589	2,957	3,371	2,032

Daily discharge, in second-feet, of Mississippi River above Sandy River, Minn., for 1895–1910—Continued.

Date.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1898.												
6	1,507	1,237	1,322	1,513	1,647	4,404	3,941	2,872	3,602	2,949	3,432	2,032
7	1,507	1,237	1,324	1,475	1,636	4,490	3,986	2,740	3,616	2,980	3,612	2,008
8	1,393	1,299	1,303	1,511	1,626	4,547	4,053	2,770	3,580	2,989	3,619	1,930
9	1,291	1,361	1,282	1,500	1,626	4,633	3,615	2,604	3,304	2,976	3,698	1,933
10	1,291	1,361	1,259	1,511	1,748	4,088	3,570	2,538	3,304	2,998	3,724	1,845
11	1,302	1,350	1,297	1,404	1,814	4,112	4,121	2,478	3,281	2,989	3,671	1,724
12	1,313	1,339	1,335	1,457	1,876	4,121	4,121	2,527	3,255	2,958	3,797	1,680
13	1,324	1,328	1,373	1,393	1,898	4,178	4,008	2,461	3,188	2,954	3,739	1,629
14	1,335	1,316	1,411	1,404	1,937	4,236	3,940	2,394	3,121	2,940	3,693	1,619
15	1,337	1,328	1,327	2,193	2,110	4,207	4,396	2,527	2,121	2,904	3,660	1,566
16	1,369	1,340	1,238	1,515	2,227	4,441	4,283	2,758	3,167	2,895	3,613	1,457
17	1,401	1,352	1,327	1,280	2,367	4,465	4,211	3,023	3,390	2,900	3,654	1,423
18	1,403	1,364	1,351	1,216	2,439	4,438	4,170	3,023	3,591	2,904	3,594	1,330
19	1,405	1,379	1,375	1,173	2,371	4,385	4,361	2,748	3,672	2,936	3,555	1,386
20	1,407	1,327	1,399	1,146	2,019	4,383	4,361	2,714	3,563	2,945	3,407	1,352
21	1,409	1,275	1,423	1,194	2,098	4,192	4,057	2,682	3,384	2,954	3,414	1,322
22	1,448	1,266	1,447	1,221	2,282	4,001	3,852	2,781	3,362	2,927	3,731	1,327
23	1,487	1,257	1,471	1,424	2,008	3,830	3,757	2,847	3,312	2,913	3,513	1,118
24	1,487	1,248	1,495	1,595	2,297	3,619	3,668	2,815	3,401	2,904	3,506	1,084
25	1,426	1,237	1,519	1,708	2,593	3,449	3,536	2,749	3,289	2,895	1,821	1,050
26	1,365	1,255	1,543	1,745	2,570	3,404	3,504	2,749	3,070	2,891	1,953	1,033
27	1,304	1,273	1,567	1,836	2,394	3,285	3,468	2,742	3,047	2,895	2,059	1,011
28	1,304	1,291	1,591	1,809	2,148	3,276	3,445	2,762	3,114	2,886	2,442	958
29	1,305	.....	1,594	1,574	2,386	3,324	3,423	2,874	3,204	2,878	2,488	934
30	1,306	.....	1,514	1,499	2,341	3,349	3,577	2,894	3,460	2,869	2,521	929
31	1,306	.....	1,476	.....	2,263	.....	3,541	2,841	.....	2,846	.....	900
1899.												
1	1,378	1,228	1,122	1,322	4,299	7,705	6,446	2,697	4,824	3,381	4,546	2,153
2	1,353	1,228	1,122	1,365	4,567	7,730	6,317	2,783	4,912	3,437	4,437	2,101
3	1,341	1,256	1,132	1,396	4,706	7,788	6,168	2,761	4,906	3,480	4,394	2,084
4	1,335	1,251	1,122	1,368	4,674	7,843	5,760	3,031	4,580	3,462	4,286	1,984
5	1,329	1,194	1,122	1,381	4,744	7,896	5,178	3,385	4,416	3,391	4,205	1,481
6	1,329	1,222	1,122	1,368	4,728	7,897	4,291	3,540	4,384	3,479	4,080	1,226
7	1,304	1,216	1,101	1,385	4,728	7,942	4,548	3,498	4,416	3,422	4,722	1,187
8	1,292	1,211	1,074	1,350	4,811	7,987	4,496	3,427	4,427	3,026	4,624	1,468
9	1,304	1,183	1,013	1,387	4,806	8,026	4,496	3,498	4,267	2,985	4,510	1,705
10	1,297	1,172	1,022	1,297	4,891	8,045	4,535	3,554	4,354	3,125	4,661	1,890
11	1,292	1,044	1,050	1,345	5,025	8,064	4,405	3,786	4,403	3,054	4,590	2,136
12	1,297	1,016	1,103	1,396	5,293	8,080	4,217	3,786	4,234	3,295	4,487	2,351
13	1,292	992	1,145	1,448	5,346	8,097	4,185	3,545	4,234	3,379	4,521	2,515
14	1,292	1,019	1,134	1,506	5,336	8,113	4,191	3,428	4,278	3,379	4,494	2,644
15	1,286	1,019	1,155	1,539	5,325	8,123	4,081	3,335	4,229	4,725	4,195	2,653
16	1,280	1,101	1,207	1,539	5,114	8,134	3,971	3,271	4,523	4,202	4,033	2,631
17	1,300	1,101	1,137	1,452	5,141	8,154	3,862	3,568	4,464	5,916	4,112	2,686
18	1,281	1,101	1,127	1,409	5,151	8,161	3,756	3,342	4,172	6,581	3,947	2,734
19	1,281	1,090	1,127	1,478	5,307	8,160	3,691	3,696	4,112	7,629	3,887	2,764
20	1,323	1,079	1,112	1,591	5,285	8,158	3,659	4,193	4,074	4,853	3,752	2,734
21	1,323	1,079	1,112	1,808	5,864	8,157	3,551	4,590	4,052	6,057	3,714	2,592
22	1,317	1,011	1,112	1,855	5,907	8,156	3,499	4,788	4,211	6,085	3,654	2,424
23	1,262	994	1,133	1,778	5,182	8,153	3,454	5,432	4,205	6,531	3,627	2,338
24	1,268	971	1,143	1,795	5,000	8,146	3,369	4,232	4,297	6,474	3,578	2,338
25	1,268	960	1,143	1,907	5,214	8,139	3,279	4,430	4,134	6,375	3,627	2,351
26	1,268	971	1,164	2,098	5,144	8,125	3,326	4,430	4,030	6,304	3,638	2,179
27	1,262	1,099	1,136	2,135	5,214	8,109	3,191	4,381	3,970	5,724	3,835	1,869
28	1,267	1,122	1,177	2,223	4,984	8,099	3,012	4,317	3,954	5,511	3,803	1,857
29	1,261	.....	1,363	2,283	4,808	8,084	2,851	4,203	4,103	5,369	3,765	1,964
30	1,328	.....	1,519	2,314	4,650	8,064	2,657	3,664	4,081	5,040	3,760	2,029
31	1,316	.....	1,612	.....	4,821	.....	2,440	3,487	.....	4,757	.....	2,007
1900.												
1	2,062	1,672	1,323	1,385	2,099	2,054	1,288	891	4,230	5,774	2,586	852
2	2,036	1,637	1,323	1,416	1,833	2,084	1,087	763	3,573	5,792	2,490	852
3	1,949	1,602	1,323	1,426	1,511	2,017	1,035	750	3,408	5,574	2,539	831
4	1,924	1,595	1,323	1,472	1,384	1,447	1,020	555	3,077	5,384	2,645	831
5	1,915	1,547	1,340	1,477	1,909	1,384	1,370	549	3,392	5,121	2,653	831
6	1,876	1,528	1,340	2,097	2,119	1,495	1,258	1,072	3,901	5,216	2,463	831
7	1,841	1,528	1,340	2,188	773	1,510	1,191	1,535	3,599	5,216	2,456	661
8	1,808	1,500	1,350	2,199	843	1,517	1,153	1,877	3,599	4,673	2,421	639
9	1,788	1,550	1,350	2,364	983	1,613	1,459	1,837	3,484	4,655	2,396	618
10	1,759	1,563	1,390	2,558	913	1,532	1,691	1,780	3,069	4,854	2,526	618

Daily discharge, in second-feet, of Mississippi River above Sandy River, Minn., for 1895–1910—Continued.

Date.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1900.												
11	1,720	1,550	1,400	2,722	1,406	1,405	1,616	2,088	3,562	5,081	2,474	728
12	1,635	1,578	1,408	2,917	1,763	1,290	1,213	2,129	3,890	4,914	2,552	719
13	1,635	1,557	1,397	2,851	1,588	1,186	1,377	1,909	4,745	4,823	2,443	694
14	1,625	1,524	1,365	2,569	1,641	1,179	1,675	2,083	4,903	4,642	2,376	578
15	1,615	1,524	1,276	2,220	1,697	1,428	1,474	2,124	7,023	4,724	2,300	574
16	1,823	1,459	1,276	2,210	1,851	1,461	1,571	2,117	7,516	4,497	2,224	574
17	1,842	1,452	1,349	2,664	1,920	1,350	1,871	2,365	9,078	4,279	2,259	653
18	1,818	1,438	1,412	2,631	2,176	1,266	1,802	2,419	9,145	3,999	2,295	641
19	1,777	1,438	1,449	2,210	2,071	1,282	1,340	2,365	9,391	3,808	2,219	641
20	1,767	1,452	1,439	1,954	2,127	1,245	974	2,461	9,572	3,618	2,043	641
21	1,762	1,433	1,439	1,918	2,043	1,208	959	2,588	9,196	3,446	1,990	673
22	1,757	1,424	1,449	1,800	2,022	1,106	1,257	2,823	9,032	3,876	1,937	673
23	1,757	1,390	1,459	1,775	2,064	1,001	1,422	3,125	8,994	3,577	1,919	673
24	1,757	1,355	1,314	2,224	2,022	1,067	1,496	3,660	9,032	3,215	1,902	696
25	1,752	1,335	1,345	2,173	1,952	1,284	1,489	3,528	8,966	2,762	1,866	704
26	1,752	1,387	1,371	2,265	2,003	1,309	1,272	3,628	8,999	2,566	1,849	713
27	1,792	1,387	1,401	2,332	1,994	1,346	994	3,716	8,900	2,502	1,813	704
28	1,816	1,387	1,401	2,614	1,939	1,309	1,054	3,628	8,834	2,539	1,803	694
29	1,635	.....	1,417	2,152	1,904	1,264	994	3,501	8,538	2,883	1,778	694
30	1,625	.....	1,466	2,148	1,911	1,153	758	3,333	7,552	3,155	932	694
31	1,596	.....	1,476	.....	1,848	.....	549	3,360	.....	2,901	.....	633
1901.												
1	601	753	1,533	2,053	5,851	4,640	6,878	3,176	3,346	2,683	3,700	2,325
2	610	763	1,453	2,053	6,025	4,640	6,905	3,255	3,306	2,648	3,694	2,334
3	610	770	1,388	2,104	6,129	4,681	6,950	2,860	3,219	2,708	3,717	2,325
4	633	780	1,348	2,171	6,185	4,647	6,950	2,662	3,158	2,825	3,717	2,136
5	633	813	1,348	2,293	6,206	4,640	6,950	2,544	3,102	3,030	3,717	2,127
6	628	913	1,284	2,324	6,185	4,536	6,591	2,480	2,790	3,124	3,759	2,001
7	584	997	1,228	2,293	6,192	4,509	6,546	2,423	2,734	3,453	3,653	1,992
8	584	851	1,448	2,113	6,241	4,446	6,495	2,692	2,632	3,553	3,688	1,974
9	584	753	1,414	2,688	6,234	4,315	6,428	3,292	2,880	3,574	3,747	2,001
10	584	858	1,430	2,837	6,486	3,887	6,332	3,324	2,900	3,609	3,747	2,001
11	627	901	1,612	3,154	6,430	3,566	6,265	2,250	2,900	3,344	3,717	2,046
12	627	964	1,620	3,458	6,402	3,465	5,318	2,242	2,900	3,385	3,653	2,046
13	627	1,047	1,724	3,995	6,354	3,472	5,177	2,336	2,773	3,385	3,571	2,046
14	619	1,080	1,741	4,267	6,399	3,437	5,161	2,423	2,763	3,397	3,453	2,023
15	628	1,118	1,821	4,416	6,301	3,499	5,054	2,352	2,712	3,408	3,453	1,978
16	646	1,052	1,813	4,687	6,176	3,983	5,542	2,344	2,773	3,322	3,453	1,955
17	650	1,079	1,829	4,772	4,657	4,363	4,918	2,348	2,834	3,310	3,629	1,739
18	519	1,146	1,749	4,901	4,490	4,577	4,188	2,316	2,854	3,310	3,559	1,622
19	528	1,196	1,765	5,030	4,072	4,674	3,860	2,308	2,854	3,281	3,489	1,626
20	519	1,319	2,006	5,192	4,404	4,736	3,287	2,143	2,720	3,287	3,489	1,622
21	510	1,419	1,894	5,289	3,972	4,770	3,062	2,158	2,720	3,639	3,489	1,604
22	510	1,523	1,861	5,354	4,002	4,575	2,787	2,474	2,730	3,639	3,489	1,595
23	528	1,543	1,820	5,464	4,049	4,630	3,087	2,774	2,565	3,645	3,489	1,595
24	546	1,620	2,286	5,587	4,243	6,598	3,059	2,940	2,550	3,651	3,489	1,595
25	598	1,519	2,334	5,677	3,922	7,344	2,468	3,035	2,550	3,641	3,489	1,654
26	620	1,485	2,286	5,768	3,797	7,682	2,412	4,028	2,580	3,629	3,489	1,659
27	643	1,519	2,181	5,826	4,335	7,979	2,446	3,972	2,889	3,617	3,489	1,659
28	629	1,519	2,119	5,890	4,238	8,256	2,480	3,845	2,848	3,374	3,789	1,659
29	633	.....	2,031	5,993	4,203	8,588	2,835	3,727	2,848	3,386	3,676	1,659
30	633	.....	1,951	6,220	4,342	8,823	2,779	3,178	2,865	3,421	3,541	1,668
31	633	.....	1,859	.....	3,819	.....	2,756	2,996	.....	3,433	.....	1,673
1902.												
1	1,656	1,492	1,448	3,192	1,962	4,541	2,588	1,708	2,272	2,374	3,110	2,943
2	1,656	1,397	1,448	3,046	2,104	4,413	2,525	2,059	2,450	2,425	3,625	2,950
3	1,656	1,216	1,490	2,783	2,245	4,447	2,404	2,163	2,552	2,297	4,165	2,936
4	1,629	1,238	1,396	2,385	2,822	4,233	2,404	1,629	2,640	2,168	4,449	2,936
5	1,614	1,365	1,438	2,269	2,570	4,062	2,549	1,492	2,692	2,156	4,839	2,973
6	1,595	1,444	1,475	2,648	2,750	4,021	2,404	1,540	2,705	2,068	5,372	3,038
7	1,536	1,311	1,469	2,789	2,678	4,124	2,353	1,586	2,679	2,042	5,709	3,153
8	1,517	1,311	1,470	2,473	2,678	4,166	2,258	1,673	2,660	2,119	5,744	3,196
9	1,507	1,295	1,474	2,064	3,038	4,121	2,529	1,653	2,609	2,223	6,011	3,288
10	1,324	1,271	1,506	2,251	2,750	4,164	2,626	1,595	2,596	2,334	6,153	3,309
11	1,324	1,192	1,515	2,286	2,822	4,206	2,684	1,589	2,558	2,231	6,330	2,543
12	1,314	1,128	1,463	2,222	2,827	4,181	2,684	1,524	2,341	2,231	6,508	2,550
13	1,522	1,176	1,500	2,269	2,834	4,085	2,684	1,511	2,379	2,532	6,597	2,550
14	1,522	1,161	1,645	2,123	3,036	3,999	2,684	1,452	2,328	2,467	6,543	2,550
15	1,512	1,136	1,708	2,006	3,097	3,914	1,990	1,417	2,407	2,377	6,561	2,422

Daily discharge, in second-feet, of Mississippi River above Sandy River, Minn., for 1895–1910—Continued.

Date.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.												
16	1,517	1,107	1,856	2,035	3,025	3,768	1,844	1,423	2,280	2,300	6,685	2,495
17	1,470	1,117	1,909	2,153	3,025	3,717	1,699	1,469	2,191	2,303	6,898	2,448
18	1,460	1,139	1,909	2,018	3,025	3,657	1,546	1,438	2,203	2,329	6,845	2,373
19	1,355	1,148	1,877	1,988	2,998	3,512	1,626	1,399	2,179	2,393	6,863	2,349
20	1,435	1,148	1,937	1,842	3,358	4,027	1,577	1,399	2,166	2,604	6,863	2,274
21	1,416	1,155	2,008	1,813	5,305	3,864	1,516	1,386	2,102	2,617	6,898	2,233
22	1,416	1,161	2,036	1,334	6,257	3,676	1,929	1,568	2,259	2,668	6,898	2,220
23	1,449	1,202	2,036	1,936	6,257	3,574	2,171	1,490	2,297	2,642	7,076	2,064
24	1,521	1,270	2,056	1,936	6,185	3,351	2,050	1,470	2,386	2,152	6,987	2,131
25	1,422	1,301	1,961	1,936	5,990	3,420	1,923	1,433	2,386	2,203	7,005	2,030
26	1,427	1,301	1,945	1,982	6,084	2,949	1,583	1,550	2,223	2,345	6,863	1,960
27	1,436	1,321	2,130	1,982	6,293	3,137	1,316	1,582	2,236	2,384	6,754	1,838
28	1,415	1,439	2,262	1,935	5,048	2,795	1,024	1,861	2,299	2,504	6,666	1,743
29	1,348	.....	2,246	1,509	4,954	2,539	1,243	2,185	2,484	2,607	6,524	1,671
30	1,401	.....	2,458	1,771	4,735	2,009	1,365	2,822	2,420	2,716	6,524	1,641
31	1,434	.....	2,342	.....	4,198	.....	1,729	2,831	.....	2,819	.....	1,573
1903.												
1	1,880	1,133	1,119	1,199	2,736	2,818	1,739	1,961	1,592	2,621	2,464	796
2	1,760	1,162	1,047	1,045	2,690	2,714	1,836	1,879	1,581	2,612	2,371	775
3	1,754	1,147	1,137	1,342	2,649	2,061	1,756	1,825	1,638	2,644	2,442	771
4	1,716	1,123	1,122	1,557	3,169	2,622	1,473	1,809	1,581	3,092	2,362	778
5	1,753	1,104	1,107	1,342	3,160	2,529	1,461	1,833	1,694	3,360	2,373	778
6	1,696	1,088	929	1,557	3,119	2,889	1,955	1,864	1,700	3,437	1,821	778
7	1,658	1,078	899	1,749	3,032	2,341	1,909	1,910	1,564	3,987	1,797	777
8	1,620	1,073	869	1,966	3,032	1,948	2,273	1,852	1,587	4,473	1,761	775
9	1,431	1,154	951	2,184	2,968	1,948	2,544	1,813	1,899	4,802	1,591	775
10	1,399	1,149	966	2,280	3,278	1,928	2,656	1,754	2,075	4,949	1,602	777
11	1,361	1,125	921	2,606	3,597	1,936	2,542	1,697	2,166	4,974	1,625	775
12	1,595	1,115	906	2,990	3,907	2,107	2,258	1,631	2,602	5,041	1,474	773
13	1,563	1,130	803	3,451	4,103	2,047	1,773	1,558	2,868	4,919	1,431	771
14	1,544	1,120	863	4,078	4,103	1,967	1,557	1,374	3,056	4,198	1,409	771
15	1,531	1,115	878	4,750	4,166	2,007	1,518	1,324	3,181	4,785	1,389	775
16	1,466	1,091	893	4,366	4,212	2,007	1,602	1,370	3,368	4,308	1,236	773
17	1,434	1,085	977	4,142	4,234	1,887	1,568	1,455	3,425	4,398	1,226	771
18	1,396	1,051	1,007	4,346	4,234	1,867	1,630	1,366	3,571	4,487	1,215	780
19	1,371	1,037	1,127	4,462	4,266	1,795	1,710	1,339	3,747	4,430	1,389	780
20	1,402	1,075	1,217	4,590	4,234	1,611	1,718	1,331	3,809	4,308	1,409	783
21	1,472	1,065	1,232	4,750	4,156	1,454	1,792	1,265	3,550	4,116	1,376	781
22	1,292	1,041	1,232	4,462	4,002	1,204	1,780	1,323	3,818	3,912	912	783
23	1,273	1,020	985	4,209	3,806	1,124	1,650	1,257	3,829	3,845	1,018	785
24	1,241	986	1,015	3,958	3,496	1,132	1,734	1,121	3,454	3,685	998	786
25	1,235	976	1,015	3,803	3,883	1,132	2,035	1,160	3,519	3,436	947	774
26	1,281	964	1,015	3,803	3,564	1,313	1,972	1,183	3,269	3,116	837	772
27	1,268	964	1,113	3,585	3,482	1,477	1,548	1,140	3,070	2,445	837	760
28	1,287	964	1,128	3,234	3,214	1,473	1,485	1,319	2,969	1,984	837	772
29	1,249	.....	1,143	3,213	3,451	1,521	1,457	1,346	2,923	1,741	837	642
30	1,190	.....	1,095	2,986	3,396	1,525	1,468	1,346	2,906	2,357	686	642
31	1,158	.....	1,185	.....	3,269	.....	1,911	1,321	.....	2,805	.....	641
1904.												
1	654	698	636	818	3,491	2,212	1,993	1,756	1,835	2,162	2,242	647
2	707	644	638	842	3,468	2,306	1,971	1,851	2,145	2,123	1,911	875
3	721	638	653	870	3,451	2,118	2,100	1,818	2,155	2,069	1,806	875
4	730	583	657	917	3,422	2,102	2,181	1,588	2,195	1,960	1,826	858
5	725	583	654	853	3,371	2,443	1,916	1,679	1,955	1,890	1,747	834
6	663	550	651	1,284	3,360	2,244	1,970	1,919	1,486	1,867	2,014	823
7	654	568	629	1,463	3,377	2,424	1,862	2,039	1,788	1,890	2,219	823
8	673	604	624	1,750	3,434	2,707	1,674	1,833	1,888	1,780	1,984	806
9	668	610	653	1,901	3,434	2,809	1,592	1,891	1,888	1,795	1,931	744
10	654	604	653	2,090	3,392	2,707	1,754	1,824	1,948	1,780	1,973	702
11	664	610	676	2,261	3,392	2,644	1,819	1,790	2,087	1,920	1,658	768
12	664	646	683	2,412	3,375	2,400	1,685	1,869	2,087	2,075	1,642	778
13	664	628	618	2,554	3,255	2,174	1,831	1,786	1,888	2,194	1,616	803
14	664	628	659	2,701	3,232	2,072	1,734	1,800	1,788	2,227	1,768	796
15	739	634	649	2,809	3,187	2,245	1,535	2,162	1,718	2,281	1,673	790
16	734	616	647	2,890	3,311	2,127	1,535	2,315	1,626	2,406	1,636	793
17	720	536	611	2,961	3,260	1,925	1,913	2,287	1,647	2,571	1,521	779
18	776	584	606	3,003	3,197	1,806	1,676	1,970	1,827	2,594	1,411	786
19	773	612	583	3,098	2,998	1,927	1,471	1,717	1,638	2,726	1,603	768
20	773	624	614	3,216	2,644	1,718	1,493	1,780	1,568	2,804	1,687	768

Daily discharge, in second-feet, of Mississippi River above Sandy River, Minn., for 1895–1910—Continued.

Date.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904.												
21	749	642	614	3,278	2,559	1,888	1,638	1,795	1,638	2,827	1,645	771
22	593	621	660	3,278	2,479	1,932	1,527	1,780	1,698	2,858	1,520	847
23	640	633	609	3,311	2,700	1,751	1,678	1,607	1,781	3,030	1,483	820
24	659	633	592	3,344	2,683	1,701	1,732	1,799	1,936	2,859	1,310	813
25	754	633	740	3,754	2,711	1,875	1,732	1,909	1,966	2,587	1,257	837
26	722	615	779	3,590	2,711	1,987	1,376	1,794	1,956	2,564	1,204	827
27	736	615	751	3,609	2,691	2,079	1,317	1,889	1,896	2,331	1,189	848
28	727	633	677	3,558	2,651	2,074	1,614	1,843	1,906	1,973	948	772
29	706	639	671	3,530	2,623	1,900	1,961	1,848	1,876	1,929	985	758
30	701	.....	665	3,535	2,583	1,746	1,918	1,857	1,836	2,240	1,001	745
31	687	.....	694	.....	2,287	.....	1,691	1,891	.....	2,652	.....	773
1905.												
1	799	668	665	1,570	2,150	3,916	6,579	5,460	5,621	5,331	3,411	3,424
2	826	683	653	1,593	1,605	3,961	6,695	5,661	5,707	5,312	3,424	3,420
3	831	679	653	1,787	1,398	3,943	6,765	6,057	6,057	5,288	3,342	3,440
4	873	682	754	1,880	2,109	3,718	7,067	6,425	6,094	5,263	3,273	3,450
5	873	679	720	2,010	2,490	3,817	7,394	7,495	6,051	5,227	3,264	3,455
6	528	675	712	2,263	2,514	3,799	7,644	7,816	5,991	5,309	3,361	3,458
7	528	679	733	2,428	2,526	4,121	7,851	8,139	5,974	4,923	3,329	3,460
8	523	679	745	2,506	2,701	3,911	7,955	8,278	5,974	4,156	3,264	3,465
9	738	637	745	2,512	2,781	4,271	8,123	8,299	5,975	3,361	3,220	3,470
10	737	658	698	2,529	2,997	4,121	8,254	8,203	5,986	3,146	3,100	3,472
11	735	565	671	2,576	3,294	4,308	8,278	7,920	5,991	3,128	2,911	3,480
12	735	565	671	2,593	3,636	3,836	8,254	7,796	6,003	3,116	3,012	3,475
13	733	565	556	2,608	4,034	3,535	8,087	7,559	6,108	3,041	3,037	3,465
14	737	588	512	2,602	4,262	3,926	7,897	7,331	6,163	3,004	2,980	3,460
15	741	721	769	2,593	4,311	3,975	7,571	7,264	6,176	3,151	3,018	3,455
16	748	634	736	2,587	4,343	4,122	7,198	7,136	6,163	3,360	3,031	3,450
17	721	617	725	2,581	4,419	5,076	6,889	7,020	6,064	3,347	2,974	3,425
18	739	689	715	2,253	4,457	5,847	6,577	6,846	5,991	3,437	2,911	3,420
19	748	689	762	2,175	4,622	6,245	6,460	6,714	5,861	3,511	2,980	3,419
20	686	581	762	2,065	4,654	6,346	6,325	6,617	5,886	3,651	3,012	3,360
21	688	574	762	1,802	4,654	6,386	6,292	6,503	5,892	3,694	3,056	3,360
22	682	591	769	1,620	4,660	6,401	6,037	6,317	5,871	3,731	3,138	3,350
23	693	591	796	1,620	4,419	6,361	5,822	6,243	5,735	3,780	3,163	3,355
24	735	595	791	1,718	4,170	5,873	5,493	6,150	5,612	3,823	3,213	3,340
25	724	595	791	1,840	3,993	6,397	5,754	6,038	5,600	3,909	3,472	3,345
26	728	670	791	1,898	3,673	6,798	5,597	5,963	5,442	4,075	3,711	3,342
27	762	697	818	1,927	3,389	6,857	5,342	5,951	5,436	4,118	3,824	3,420
28	754	586	931	2,001	3,127	6,870	5,330	5,686	5,442	4,051	3,799	3,425
29	758	.....	888	1,972	2,871	6,885	5,330	5,624	5,467	4,032	3,742	3,420
30	684	.....	931	2,001	2,712	6,918	5,330	5,589	5,436	3,971	3,459	3,390
31	641	.....	1,104	.....	2,712	.....	5,330	5,514	.....	3,971	.....	3,420
1906.												
1	3,440	2,578	2,945	2,703	7,306	5,770	4,780	2,440	1,966	2,636	2,793	3,250
2	3,440	2,516	2,929	2,881	7,158	5,526	4,798	2,406	1,971	2,822	2,741	3,232
3	3,450	2,516	2,914	3,060	7,010	5,206	4,786	2,373	1,976	3,008	2,687	3,213
4	3,445	2,496	2,783	3,117	6,862	5,206	4,675	2,339	1,983	3,194	2,683	3,195
5	3,420	2,476	2,651	3,173	6,714	5,215	4,583	2,306	1,985	3,380	2,679	3,176
6	3,415	2,456	2,520	3,230	5,960	5,105	4,127	2,272	1,990	3,570	2,675	3,158
7	3,410	2,436	2,522	3,287	5,206	5,325	3,831	2,239	1,991	3,467	2,672	3,137
8	3,408	2,416	2,524	3,370	5,004	5,580	3,572	2,205	1,798	3,364	2,710	3,119
9	3,329	2,396	2,526	3,525	4,986	5,813	3,492	2,172	1,795	3,261	2,748	3,023
10	3,250	2,397	2,528	3,690	5,056	5,830	3,948	2,138	1,790	3,158	2,787	2,926
11	3,171	2,511	2,571	3,890	4,668	5,860	3,849	2,105	1,832	3,055	2,779	2,830
12	3,092	2,626	2,614	4,170	4,504	5,804	3,868	2,071	1,830	2,952	2,770	2,733
13	2,935	2,741	2,612	4,780	4,488	5,897	3,480	2,037	1,789	2,849	2,762	2,637
14	2,895	2,856	2,610	5,624	4,398	5,890	3,412	2,000	1,748	2,746	2,753	2,540
15	2,855	2,971	2,608	6,150	4,318	5,579	3,412	1,983	1,747	2,741	2,745	2,443
16	2,815	3,086	2,606	6,245	4,475	5,504	3,412	1,966	1,821	2,566	2,736	2,444
17	2,775	3,201	2,604	6,380	4,632	5,409	3,137	1,949	1,895	2,391	2,727	2,446
18	2,735	3,270	2,620	6,646	4,789	5,308	2,957	1,949	1,969	2,216	2,774	2,447
19	2,695	3,240	2,637	6,880	4,948	5,209	2,945	1,861	2,043	2,041	2,822	2,449
20	2,664	3,209	2,654	7,156	4,861	5,062	3,313	1,773	2,117	1,866	2,869	2,450
21	2,663	3,179	2,646	7,310	4,906	4,915	3,288	1,684	2,191	2,044	2,917	2,451
22	2,662	3,045	2,638	7,525	5,157	4,708	3,381	1,685	2,271	2,222	2,964	2,453
23	2,661	2,911	2,630	7,537	5,290	4,618	3,708	1,718	2,275	2,401	3,012	2,418
24	2,655	2,778	2,622	7,549	5,441	4,673	3,936	1,753	2,300	2,579	3,060	2,382
25	2,650	2,844	2,583	7,561	5,583	4,728	3,689	1,787	2,325	2,757	3,087	2,347

Daily discharge, in second-feet, of Mississippi River above Sandy River, Minn., for 1895–1910—Continued.

Date.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906.												
26	2,649	2,910	2,544	7,573	5,726	4,783	3,665	1,822	2,350	2,936	3,114	2,311
27	2,649	2,976	2,505	7,585	5,870	4,838	3,517	1,856	2,375	3,118	3,141	2,276
28	2,648	2,926	2,510	7,571	5,854	4,893	3,204	1,891	2,400	3,050	3,168	2,240
29	2,647	.....	2,515	7,497	5,396	4,949	2,310	1,925	2,425	2,982	3,195	2,204
30	2,645	.....	2,520	7,454	5,304	5,006	2,479	1,960	2,450	2,914	3,222	2,199
31	2,640	.....	2,525	.....	5,450	.....	2,571	1,961	.....	2,845	.....	2,194
1907.												
1	2,207	2,197	2,007	2,587	4,303	3,490	2,594	4,062	2,364	1,952	2,348	1,295
2	2,221	2,166	2,009	2,627	3,601	3,404	2,456	4,071	2,246	1,951	2,486	1,273
3	2,234	2,126	2,002	2,667	2,900	3,317	2,317	4,081	2,129	1,950	2,578	1,252
4	2,248	2,086	1,994	2,707	2,197	3,231	2,179	4,045	2,011	1,948	2,671	1,230
5	2,263	2,046	1,987	2,747	2,230	3,144	2,041	4,008	1,894	1,946	2,763	1,208
6	2,308	2,006	1,979	2,787	2,263	3,058	1,902	3,972	1,776	1,949	2,856	1,187
7	2,354	1,966	1,972	2,837	2,296	2,971	2,038	3,925	1,658	1,953	2,948	1,166
8	2,399	1,926	1,964	2,887	2,329	2,882	2,174	3,899	1,673	1,956	3,042	1,132
9	2,445	1,885	1,955	2,937	2,362	2,964	2,311	3,862	1,688	1,960	3,136	1,098
10	2,490	1,865	1,954	2,987	2,395	3,045	2,447	3,825	1,703	1,963	3,126	1,064
11	2,536	1,845	1,954	3,037	2,428	3,127	2,584	3,784	1,719	1,967	3,116	1,030
12	2,581	1,824	1,953	3,087	2,590	3,208	2,722	3,743	1,734	1,971	3,106	996
13	2,577	1,804	1,953	3,137	2,751	3,290	2,860	3,702	1,749	1,998	3,096	962
14	2,573	1,784	1,953	3,187	2,912	3,371	2,842	3,661	1,765	2,025	3,086	927
15	2,569	1,763	1,952	3,237	3,073	3,452	2,824	3,620	1,876	2,052	3,076	927
16	2,565	1,742	1,952	3,287	3,235	3,443	2,805	3,579	1,987	2,080	3,066	926
17	2,561	1,799	1,953	3,337	3,396	3,434	2,787	3,538	2,098	2,107	2,966	926
18	2,556	1,816	1,953	3,387	3,558	3,425	2,768	3,481	2,210	2,134	2,866	926
19	2,551	1,853	1,954	3,437	3,665	3,416	2,749	3,423	2,321	2,162	2,766	925
20	2,527	1,890	1,954	3,487	3,772	3,407	2,729	3,366	2,432	2,176	2,666	925
21	2,502	1,927	1,955	3,754	3,879	3,398	2,889	3,308	2,544	2,190	2,566	924
22	2,477	1,964	1,955	4,021	3,986	3,388	3,050	3,251	2,467	2,204	2,466	897
23	2,452	2,001	1,955	4,287	4,093	3,306	3,210	3,193	2,390	2,218	2,366	869
24	2,427	2,002	2,033	4,554	4,200	3,224	3,371	3,136	2,313	2,232	2,216	842
25	2,402	2,003	2,112	4,820	4,306	3,142	3,531	3,043	2,235	2,246	2,066	814
26	2,377	2,004	2,190	5,087	4,190	3,060	3,692	2,949	2,158	2,260	1,916	784
27	2,347	2,005	2,269	5,354	4,073	2,977	3,853	2,856	2,081	2,250	1,766	754
28	2,317	2,006	2,347	5,204	3,957	2,895	3,903	2,762	2,003	2,240	1,616	722
29	2,287	.....	2,426	5,154	3,840	2,812	3,953	2,669	1,978	2,230	1,466	720
30	2,257	.....	2,507	5,004	3,724	2,732	4,003	2,575	1,953	2,220	1,316	718
31	2,227	.....	2,547	.....	3,607	.....	4,053	2,481	.....	2,210	.....	716
1908.												
1	691	597	835	869	2,208	3,501	3,644	2,847	1,822	2,475	1,934	1,053
2	667	597	838	888	2,400	3,501	3,634	2,827	1,842	2,480	1,861	1,054
3	642	596	841	906	2,315	3,501	3,624	2,807	1,862	2,485	1,787	1,055
4	618	596	844	925	2,230	3,501	3,614	2,787	1,884	2,492	1,714	1,056
5	617	596	848	935	2,145	3,501	3,501	2,767	1,904	2,499	1,641	1,057
6	616	595	851	945	2,060	3,501	3,387	2,747	1,909	2,506	1,567	1,035
7	615	595	855	955	1,975	3,601	3,274	2,727	1,914	2,513	1,492	1,013
8	614	595	857	965	1,890	3,701	3,160	2,707	1,919	2,520	1,452	991
9	613	596	859	975	1,805	3,801	3,047	2,557	1,924	2,527	1,412	969
10	612	597	861	985	1,885	3,901	2,934	2,407	1,929	2,534	1,372	947
11	611	598	863	995	1,965	4,001	2,819	2,257	1,934	2,466	1,332	925
12	610	599	865	1,000	2,045	4,101	2,786	2,107	1,939	2,397	1,292	903
13	609	600	867	1,005	2,125	4,201	2,753	1,957	1,949	2,329	1,252	923
14	608	600	870	1,010	2,205	4,181	2,720	1,807	1,959	2,260	1,212	943
15	607	600	864	1,015	2,285	4,161	2,686	1,657	1,969	2,192	1,202	963
16	606	642	858	1,020	2,365	4,141	2,653	1,652	1,979	2,123	1,192	983
17	605	684	852	1,025	2,358	4,121	2,620	1,647	1,989	2,055	1,182	1,003
18	604	726	846	1,030	2,351	4,101	2,586	1,642	1,999	2,058	1,172	1,023
19	603	768	840	1,035	2,344	4,081	2,633	1,637	2,009	2,061	1,162	1,043
20	602	810	834	1,040	2,337	4,060	2,680	1,632	2,072	2,064	1,152	1,028
21	601	853	828	1,045	2,330	4,007	2,727	1,627	2,135	2,067	1,142	1,013
22	600	860	831	1,050	2,323	3,953	2,775	1,622	2,198	2,070	1,132	997
23	600	856	834	1,055	2,316	3,900	2,822	1,642	2,261	2,073	1,122	982
24	600	852	837	1,060	2,485	3,846	2,869	1,662	2,324	2,077	1,112	967
25	600	847	841	1,065	2,654	3,793	2,917	1,682	2,387	2,067	1,102	951
26	600	843	844	1,255	2,823	3,739	2,907	1,702	2,450	2,057	1,092	935
27	600	839	847	1,446	2,992	3,684	2,897	1,722	2,455	2,047	1,082	928
28	598	834	851	1,636	3,161	3,674	2,887	1,742	2,460	2,037	1,072	921
29	598	832	855	1,827	3,330	3,664	2,877	1,762	2,465	2,027	1,062	914
30	598	.....	859	2,017	3,500	3,654	2,867	1,782	2,470	2,017	1,052	907
31	597	.....	863	.....	3,670	.....	2,857	1,802	.....	2,007	.....	900

Daily discharge, in second-feet, of Mississippi River above Sandy River, Minn., for 1895–1910—Continued.

Date.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1	893	887	770	989	1,210	2,241	1,950	1,400	3,500	2,920	2,700	2,200
2	886	864	765	994	1,371	2,227	1,949	1,400	3,200	3,000	2,800	2,100
3	885	841	761	999	1,531	2,213	1,949	1,500	3,000	2,900	2,800	2,100
4	884	818	757	1,016	1,692	2,119	1,900	1,400	2,800	2,840	2,700	2,000
5	883	795	753	1,034	1,853	2,163	1,855	1,200	2,700	2,760	2,700	2,000
6	882	772	748	1,052	2,014	2,113	1,740	1,300	2,580	2,780	2,656	1,991
7	881	779	755	1,069	2,175	2,063	1,580	1,400	2,500	2,720	2,550	1,982
8	880	782	763	1,087	2,337	2,013	1,600	1,500	2,500	2,660	2,450	1,973
9	879	794	770	1,105	2,346	1,960	1,600	1,900	2,520	2,623	2,480	1,964
10	878	801	778	1,124	2,355	1,960	1,622	1,700	2,450	2,500	2,480	1,955
11	876	808	785	1,106	2,364	1,860	1,800	2,100	2,100	2,380	2,490	1,943
12	874	816	793	1,087	2,373	1,823	1,900	2,700	2,100	2,280	2,500	1,943
13	872	824	800	1,069	2,382	1,821	1,700	2,800	2,100	2,350	2,480	1,943
14	869	822	812	1,050	2,391	1,819	1,700	3,000	2,100	2,220	2,500	1,943
15	867	819	824	1,031	2,399	1,817	1,850	3,400	2,100	2,075	2,500	1,943
16	862	817	836	1,013	2,376	1,815	1,700	3,670	2,000	2,075	2,800	1,943
17	882	814	848	992	2,353	1,813	1,610	3,870	2,000	2,100	2,800	1,942
18	902	812	860	1,013	2,330	1,811	1,700	3,980	1,900	2,200	2,700	1,942
19	922	808	872	1,034	2,304	1,810	1,700	4,150	1,850	2,300	2,800	1,891
20	942	804	884	1,055	2,281	1,852	1,900	4,380	1,800	2,400	2,600	1,840
21	962	801	894	1,076	2,258	1,894	2,000	4,550	1,700	2,450	2,500	1,789
22	982	797	904	1,097	2,237	1,936	2,100	4,590	1,900	2,480	2,500	1,738
23	1,003	794	914	1,118	2,241	1,978	2,200	4,650	2,100	2,400	2,500	1,687
24	990	790	924	1,139	2,245	2,020	2,300	4,800	2,250	2,500	2,500	1,646
25	976	786	934	1,140	2,249	2,062	2,400	5,000	2,300	2,600	2,500	1,459
26	963	782	944	1,135	2,253	2,063	2,100	4,800	2,450	2,590	2,500	1,450
27	949	778	954	1,130	2,257	2,063	1,710	4,700	2,500	2,650	2,500	1,441
28	936	774	964	1,145	2,261	2,040	1,700	4,500	2,500	2,731	2,500	1,431
29	922	.....	970	1,130	2,261	2,000	1,580	4,200	2,600	2,750	2,500	1,422
30	907	.....	980	1,200	2,260	1,950	1,400	4,000	2,750	2,780	2,500	1,413
31	910	.....	985	.....	2,255	.....	1,310	3,800	.....	2,800	.....	1,403
1910.												
1	1,393	1,125	1,363	2,485	2,876	2,107	2,131	2,328	2,792	2,354	2,381	663
2	1,348	1,126	1,351	2,485	2,843	2,085	2,137	2,367	2,834	2,304	2,194	663
3	1,303	1,127	1,339	2,499	2,810	2,063	2,144	2,405	2,876	2,255	2,007	664
4	1,258	1,128	1,327	2,513	2,777	2,040	2,151	2,444	2,918	2,205	1,810	665
5	1,213	1,129	1,314	2,527	2,744	2,063	2,159	2,482	2,960	2,156	1,623	667
6	1,168	1,166	1,363	2,541	2,711	2,086	2,166	2,521	3,002	2,106	1,440	667
7	1,123	1,203	1,412	2,555	2,710	2,110	2,173	2,559	2,965	2,056	1,349	668
8	1,112	1,240	1,461	2,569	2,615	2,133	2,181	2,598	2,928	2,006	1,257	669
9	1,107	1,277	1,510	2,574	2,520	2,156	2,189	2,636	2,891	1,955	1,229	669
10	1,102	1,314	1,559	2,479	2,425	2,180	2,186	2,676	2,854	1,905	1,220	672
11	1,097	1,351	1,608	2,384	2,330	2,204	2,183	2,716	2,817	1,871	1,171	672
12	1,092	1,353	1,613	2,289	2,235	2,194	2,180	2,756	2,779	1,832	1,143	680
13	1,087	1,352	1,697	2,194	2,140	2,180	2,177	2,796	2,728	1,793	1,115	670
14	1,082	1,352	1,781	2,099	2,137	2,165	2,174	2,835	2,676	1,754	1,087	670
15	1,081	1,352	1,865	2,004	2,211	2,151	2,170	2,834	2,625	1,715	1,058	678
16	1,079	1,352	1,949	2,000	2,285	2,137	2,167	2,832	2,573	1,676	1,030	680
17	1,077	1,352	2,033	2,188	2,359	2,122	2,164	2,831	2,521	1,636	1,002	682
18	1,075	1,352	2,117	2,376	2,433	2,107	2,160	2,829	2,468	1,567	974	684
19	1,073	1,352	2,118	2,564	2,507	2,106	2,157	2,828	2,416	1,498	946	684
20	1,071	1,355	2,396	2,752	2,581	2,105	2,153	2,826	2,415	1,429	918	686
21	1,069	1,355	2,674	2,940	2,584	2,104	2,150	2,824	2,414	1,359	890	688
22	1,068	1,360	2,952	3,128	2,529	2,103	2,147	2,816	2,413	1,290	861	690
23	1,076	1,360	3,230	3,132	2,473	2,102	2,144	2,808	2,412	1,220	832	692
24	1,084	1,365	3,508	3,095	2,418	2,101	2,163	2,800	2,411	1,370	804	693
25	1,092	1,365	3,786	3,058	2,362	2,101	2,183	2,792	2,410	1,420	776	687
26	1,100	1,368	3,787	3,021	2,307	2,106	2,203	2,784	2,409	2,076	747	681
27	1,108	1,370	3,570	2,984	2,251	2,111	2,223	2,776	2,408	2,426	718	675
28	1,116	1,375	3,353	2,947	2,195	2,116	2,243	2,768	2,407	2,506	700	669
29	1,117	.....	3,136	2,910	2,170	2,121	2,263	2,760	2,405	2,576	681	663
30	1,120	.....	2,919	2,909	2,145	2,126	2,283	2,752	2,403	2,500	662	657
31	1,125	.....	2,702	.....	2,120	.....	2,290	2,750	.....	2,568	.....	651

Monthly discharge of Mississippi River above Sandy River, Minn., for 1895–1910.

[Drainage area, 4,510 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in millions of cubic feet.
1895.						
September	2,286	2,192	2,209	0.490	0.55	5,730
October	2,429	1,870	2,148	.476	.55	5,750
November	2,258	1,251	1,849	.410	.46	4,790
December	1,216	477	751	.167	.19	2,000
1896.						
January	530	380	452	.100	.12	1,210
February	460	115	323	.072	.08	809
March	541	165	311	.069	.08	833
April	4,645	516	2,003	.444	.50	5,190
May						
June (6–30)	3,840	1,814	2,431	.539	.50	5,040
July	2,210	1,170	1,613	.358	.41	4,320
August	2,575	1,687	2,288	.507	.58	6,130
September	2,450	1,965	2,246	.498	.56	5,820
October	3,085	2,059	2,641	.586	.68	7,070
November	3,245	1,100	1,919	.425	.47	4,970
December	1,138	799	900	.200	.23	2,410
1897.						
January	1,010	580	783	.174	.20	2,100
February	900	651	740	.164	.18	1,790
March	1,069	616	743	.165	.19	1,990
April	5,843	1,417	3,770	.836	.93	9,770
May	3,857	1,838	2,866	.635	.73	7,680
June	3,873	2,308	3,209	.712	.79	8,320
July	7,789	2,999	6,101	1.35	1.56	16,300
August	4,685	2,010	3,088	.685	.79	8,270
September	2,961	2,174	2,722	.604	.67	7,060
October	3,127	2,007	2,579	.572	.66	6,910
November						
December	2,971	1,339	2,167	.480	.55	5,800
1898.						
January	1,716	1,291	1,420	.315	.36	3,800
February	1,379	1,207	1,290	.286	.30	3,120
March	1,594	1,238	1,387	.308	.36	3,710
April	2,193	1,146	1,490	.330	.37	3,860
May	2,593	1,514	2,041	.453	.52	5,470
June	4,633	2,344	3,867	.857	.96	10,000
July	4,396	3,423	3,847	.853	.98	10,300
August	3,278	2,394	2,806	.622	.72	7,510
September	3,672	3,047	3,347	.742	.83	8,680
October	3,038	2,846	2,936	.651	.75	7,860
November	3,797	1,821	3,318	.736	.82	8,600
December	2,042	900	1,541	.342	.39	4,130
The year	4,633	900	2,441	.541	7.36	77,000
1899.						
January	1,378	1,261	1,301	.288	.33	3,480
February	1,256	960	1,104	.245	.26	2,670
March	1,612	1,022	1,158	.257	.30	3,100
April	2,314	1,297	1,615	.358	.40	4,190
May	5,907	4,299	5,034	1.12	1.29	13,500
June	8,161	7,705	8,044	1.78	1.99	20,800
July	6,456	2,440	4,093	.908	1.05	11,000
August	5,432	2,697	3,744	.830	.96	10,000
September	4,912	3,954	4,308	.955	1.07	11,200
October	7,629	2,983	4,659	1.03	1.19	12,500
November	4,722	3,578	4,116	.913	1.02	10,700
December	2,764	1,187	2,163	.480	.55	5,790
The year	8,161	960	3,445	.764	10.41	109,000

Monthly discharge of Mississippi River above Sandy River, Minn., for 1895–1910—Contd.

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in millions of cubic feet.
1900.						
January	2,062	1,596	1,781	0.395	0.46	4,770
February	1,672	1,335	1,492	.331	.34	3,610
March	1,476	1,276	1,377	.305	.35	3,690
April	2,917	1,385	2,153	.477	.53	5,580
May	2,176	773	1,752	.389	.45	4,690
June	2,084	1,087	1,396	.310	.35	3,620
July	1,871	549	1,279	.284	.33	3,430
August	3,716	549	2,276	.505	.58	6,100
September	9,572	3,069	6,400	1.42	1.58	16,600
October	5,792	2,502	4,192	.929	1.07	11,200
November	2,653	932	2,205	.489	.55	5,720
December	852	574	698	.155	.18	1,870
The year	9,572	549	2,250	.499	6.77	70,900
1901.						
January	650	510	597	.132	.15	1,600
February	1,620	753	1,117	.248	.26	2,700
March	2,334	1,228	1,747	.387	.45	4,680
April	6,220	2,053	4,129	.916	1.02	10,700
May	6,486	3,797	5,236	1.16	1.34	14,000
June	8,823	3,437	5,131	1.14	1.27	13,300
July	6,950	2,412	4,705	1.04	1.20	12,600
August	4,028	2,143	2,803	.622	.72	7,510
September	3,346	2,550	2,843	.630	.70	7,370
October	3,651	2,648	3,345	.742	.86	8,960
November	3,789	3,453	3,601	.798	.89	9,330
December	2,334	1,595	1,869	.414	.48	5,010
The year	8,823	510	3,094	.686	9.34	97,800
1902.						
January	1,656	1,314	1,477	.327	.38	3,960
February	1,492	1,107	1,248	.278	.29	3,020
March	2,458	1,396	1,787	.396	.46	4,790
April	3,192	1,334	2,165	.480	.54	5,610
May	6,293	1,962	3,772	.836	.96	10,100
June	4,541	2,009	3,755	.833	.93	9,730
July	2,684	1,024	2,048	.454	.52	5,480
August	2,831	1,386	1,674	.371	.43	4,480
September	2,705	2,102	2,399	.532	.59	6,220
October	2,819	2,042	2,375	.527	.61	6,360
November	7,076	3,110	6,135	1.36	1.52	15,900
December	3,309	1,573	2,464	.546	.63	6,600
The year	7,076	1,024	2,608	.578	7.86	82,200
1903.						
January	1,880	1,158	1,460	.324	.37	3,910
February	1,162	964	1,076	.238	.25	2,600
March	1,232	803	1,028	.228	.26	2,750
April	4,750	1,145	3,136	.695	.78	8,130
May	4,266	2,649	3,568	.792	.91	9,560
June	2,889	1,124	1,879	.416	.46	4,870
July	2,656	1,457	1,816	.403	.46	4,860
August	1,961	1,121	1,507	.334	.39	4,040
September	3,829	1,564	2,733	.606	.68	7,080
October	5,041	1,741	3,737	.829	.96	10,000
November	2,464	686	1,455	.323	.36	3,770
December	796	641	763	.169	.19	2,040
The year	5,041	641	2,013	.446	6.07	63,600
1904.						
January	776	593	700	.155	.18	1,870
February	698	536	616	.137	.15	1,540
March	779	583	653	.145	.17	1,750
April	3,754	818	2,516	.558	.62	6,520
May	3,491	2,287	3,056	.678	.78	8,180
June	2,809	1,701	2,135	.473	.53	5,530
July	2,181	1,317	1,738	.385	.44	4,650
August	2,315	1,588	1,861	.413	.48	4,980
September	2,195	1,486	1,855	.411	.46	4,810
October	3,030	1,780	2,289	.508	.59	6,130
November	2,242	948	1,614	.358	.40	4,180
December	875	647	794	.176	.20	2,130
The year	3,754	536	1,652	.366	5.00	52,300

Monthly discharge of Mississippi River above Sandy River, Minn., for 1895–1910—Contd.

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in millions of cubic feet.
1905.						
January	873	523	723	0.160	0.19	1,940
February	721	565	637	.141	.15	1,540
March	1,104	512	752	.167	.19	2,010
April	2,608	1,570	2,137	.474	.53	5,540
May	4,660	1,398	3,409	.756	.87	9,130
June	6,918	3,535	5,085	1.13	1.26	13,200
July	8,278	5,330	6,759	1.50	1.73	18,100
August	8,299	5,460	6,761	1.50	1.73	18,100
September	6,176	5,436	5,859	1.30	1.45	15,200
October	5,331	3,004	3,975	.881	1.02	10,600
November	3,824	2,911	3,248	.720	.80	8,420
December	3,480	3,340	3,422	.759	.88	9,160
The year	8,299	512	3,564	.790	10.80	113,000
1906.						
January	3,450	2,640	2,961	.657	.76	7,930
February	3,301	2,396	2,788	.618	.64	6,740
March	2,945	2,505	2,620	.581	.67	7,020
April	7,585	2,703	5,504	1.22	1.36	14,300
May	7,306	4,318	5,397	1.20	1.38	14,500
June	5,897	4,618	5,274	1.17	1.30	13,700
July	4,798	2,310	3,617	.802	.92	9,690
August	2,440	1,684	2,020	.448	.52	5,410
September	2,450	1,747	2,046	.454	.51	5,300
October	3,570	1,866	2,810	.623	.72	7,530
November	3,222	2,672	2,860	.634	.71	7,410
December	3,250	2,194	2,655	.589	.68	7,110
The year	7,585	1,684	3,379	.749	10.17	107,000
1907.						
January	2,581	2,207	2,381	.528	.61	6,380
February	2,197	1,742	1,939	.430	.45	4,690
March	2,547	1,952	2,053	.455	.52	5,500
April	5,354	2,587	3,584	.795	.89	9,290
May	4,306	2,197	3,294	.730	.84	8,820
June	3,490	2,732	3,200	.710	.79	8,290
July	4,053	1,902	2,891	.641	.74	7,740
August	4,081	2,481	3,479	.771	.89	9,320
September	2,544	1,658	2,038	.452	.50	5,280
October	2,260	1,946	2,087	.463	.53	5,590
November	3,136	1,316	2,584	.573	.64	6,700
December	1,295	716	972	.287	.33	2,600
The year	5,354	716	2,542	.564	7.73	80,200
1908.						
January	691	597	611	.135	.16	1,640
February	860	595	696	.154	.17	1,740
March	870	828	849	.188	.22	2,270
April	2,017	869	1,099	.244	.27	2,850
May	3,670	1,805	2,415	.535	.60	6,470
June	4,201	3,501	3,835	.850	.95	9,940
July	3,644	2,586	2,972	.659	.76	7,960
August	2,847	1,622	2,062	.457	.53	5,520
September	2,470	1,822	2,077	.461	.51	5,380
October	2,534	2,007	2,245	.498	.57	6,010
November	1,934	1,052	1,311	.291	.32	3,400
December	1,057	900	980	.217	.25	2,620
The year	4,201	595	1,763	.391	5.33	55,800
1909.						
January	1,003	862	909	.202	.23	2,430
February	887	772	806	.179	.19	1,950
March	985	748	841	.186	.21	2,250
April	1,200	989	1,074	.238	.27	2,780
May	2,399	1,210	2,168	.481	.55	5,810
June	2,241	1,810	1,977	.438	.49	5,120
July	2,400	1,310	1,810	.401	.46	4,850
August	5,000	1,200	3,172	.703	.81	8,490
September	3,500	1,700	2,362	.524	.58	6,120
October	3,000	2,075	2,543	.564	.65	6,810
November	2,800	2,450	2,583	.573	.64	6,700
December	2,200	1,403	1,820	.404	.47	4,870
The year	5,000	748	1,839	.408	5.55	58,200

Monthly discharge of Mississippi River above Sandy River, Minn., for 1895–1910—Contd.

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in millions of cubic feet.
1910.						
January	1,393	1,068	1,129	0.250	0.29	3,020
February	1,375	1,125	1,295	.287	.30	3,130
March	3,787	1,314	2,219	.492	.57	5,940
April	3,132	2,000	2,607	.578	.64	6,760
May	2,876	2,120	2,445	.542	.62	6,550
June	2,204	2,040	2,119	.470	.52	5,490
July	2,290	2,131	2,180	.483	.56	5,840
August	2,835	2,328	2,701	.599	.69	7,230
September	3,002	2,403	2,638	.585	.65	6,840
October	2,576	1,220	1,915	.425	.49	5,130
November	2,381	662	1,154	.256	.29	2,990
December	693	651	674	.149	.17	1,800
The year	3,787	651	1,923	.426	5.79	60,700

MISSISSIPPI RIVER NEAR FORT RIPLEY, MINN.

This station, which is located at the highway bridge 1 mile north of Fort Ripley, was established June 25, 1909, to obtain data for use in determining the power available on the upper Mississippi.

The nearest tributary, Nokasippi River, enters the main stream a short distance below the bridge. The nearest dams are at Little Falls below and at Brainerd above Fort Ripley.

The flow at Fort Ripley, as at all stations on the upper Mississippi, is controlled by the Government dams on the headwaters for the purpose of increasing the low-water open flow for navigation.

During the open-water season the river is used extensively for driving logs which are likely to form jams on the rapids a few hundred feet below the bridge and cause temporary backwater at the gage. This effect became so pronounced during 1910 that the station was discontinued September 30. Ice is present and observations at this station are discontinued from December to March.

Discharge measurements are made from the bridge to which the staff gage is attached. A gage belonging to the United States Weather Bureau is also fastened to the pier that holds the Geological Survey gage. The datum of the Weather Bureau gage is 1.40 feet higher than that of the survey gage. The datum of the staff gage has remained unchanged since the station was established.

Owing to the changeable conditions of flow no estimates of daily discharge have been made and only the base data are published herewith.

Discharge measurements of Mississippi River near Fort Ripley, Minn., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 23	G. A. Gray	363	2,410	7.66	8,700
May 20	....do	352	1,870	6.21	4,930
July 23	Robert Follansbee	.....	1,550	*a* 5.45	2,530

a Backwater from log jam.

Daily gage height, in feet, of Mississippi River near Fort Ripley, Minn., for 1910.

[Observer, L. A. White.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	6.78	6.66	6.18	5.34	5.06	5.75
2	.....	6.64	6.66	6.08	5.22	5.35	5.75
3	.....	6.52	6.59	6.04	5.12	5.35	5.81
4	.....	6.61	6.51	6.05	4.98	5.34	5.76
5	.....	7.41	6.50	6.04	5.04	5.32	5.78
6	.....	6.82	6.48	6.04	5.26	5.30	5.90
7	.....	6.95	6.48	6.04	5.15	5.25	5.86
8	.....	6.98	6.38	5.90	5.22	5.22	5.85
9	.....	6.92	6.38	5.78	5.28	5.45	5.84
10	.....	6.79	6.38	5.72	5.24	5.44	5.84
11	.....	6.78	6.30	5.72	5.18	5.44	5.78
12	.....	6.76	6.18	5.66	5.48	5.49	5.72
13	.....	6.65	6.14	5.62	5.42	5.56	5.91
14	.....	6.50	6.08	5.70	5.46	5.55	5.92
15	8.12	6.56	6.05	5.62	5.38	5.52	5.85
16	8.92	6.61	6.05	5.70	5.41	5.78	5.98
17	8.26	6.70	6.15	5.79	5.35	5.72	5.94
18	7.76	6.85	6.11	5.86	5.22	5.69	5.89
19	7.96	7.11	6.10	5.85	5.51	5.72	5.70
20	7.45	7.21	6.11	5.75	5.45	5.69	5.68
21	7.52	7.25	6.15	5.88	5.42	5.62	5.59
22	7.64	7.31	6.08	5.54	5.42	5.58	5.55
23	7.66	7.31	6.12	5.28	5.38	5.79	5.51
24	7.65	7.40	6.24	5.18	5.46	5.72	5.50
25	7.65	7.30	6.25	5.18	5.41	5.69	5.45
26	7.65	7.15	6.25	5.15	5.50	5.65	5.52
27	7.61	7.09	6.28	5.18	5.04	5.68	5.94
28	7.60	6.99	6.29	5.41	5.01	5.62	6.02
29	7.48	6.88	6.22	5.36	5.00	5.54	5.98
30	7.24	6.76	6.22	5.34	5.08	5.81	6.02
31	6.96	.....	6.28	.....	5.04	5.81	.....

NOTE.—Gage heights were seriously affected by log jams below the station.

MISSISSIPPI RIVER AT ANOKA, MINN.

This station, which is located at the highway bridge connecting Anoka with Champlin, Minn., was established May 8, 1905, to obtain data for use in studies of power, sewage disposal and navigation problems. The station was temporarily discontinued from July 20 to August 10, 1906.

Rum River enters a short distance below the station.

The nearest dam is at Minneapolis, but owing to the intervening fall of the river the influence of the dam does not extend to the Anoka station. The first dam above Anoka is at St. Cloud. The

flow of the river is controlled by Government dams on the upper river for the purpose of increasing the low-water open-season flow in the interest of navigation.

Although the river is used extensively for log driving, there is very little backwater except that caused for a few days by log jams forming below the station. The river is frozen and observations are discontinued from December to March, inclusive.

The winter flow at this station can be estimated very closely from the records of Mississippi River at Minneapolis as kept by the St. Anthony Falls Water Power Co. by rating the spillway as a weir and noting the amount of water passing the wheels. From these records a quantity, depending on the year, has been subtracted to allow for the flow of Rum River and a few other small streams which enter the Mississippi between the Anoka station and Minneapolis.

The original United States Geological Survey staff gage was set to read the same as the United States Engineer Corps gage placed on the same pier in 1896. This latter gage was read for one year, during which time frequent discharge measurements were made. The staff has since been replaced by a chain gage attached to the bridge. The gage datum is the same as that used by the engineers of the Army corps in 1896 and 1897, and has not been changed since the station was established.

Discharge measurements are made from the highway bridge. Although no measurements were made during 1907 and 1908, those made in 1909 and 1910 indicate no change in the rating curve as developed in 1897, 1905, and 1906, and it can therefore be applied to all gage heights since the station was established.[1] This permanence of condition indicates that the records of flow are reliable.

The daily discharges and monthly estimates for all years prior to 1910, inclusive, have been published in "Report of water resources investigation of Minnesota during 1909–10," by the State Drainage Commission, St. Paul, Minn.

Discharge measurements of Mississippi River at Anoka, Minn., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 14	G. A. Gray	724	3,160	0.81	5,910
Aug. 13	Robert Follansbee	683	2,360	−.36	3,470

[1] Gage heights for 1905 to 1908 have been published in Water-Supply Papers 171, p. 53; 207, p. 44; and 245, pp. 71 and 72.

Daily gage height, in feet, of Mississippi River at Anoka, Minn., for 1897.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	7.12	3.50	1.17	2.60	4.20	0.90	16	5.97	1.82	1.84	6.24	1.52	.....
2	8.22	.....	1.37	2.68	4.12	.88	17	5.74	1.98	1.92	5.96	1.53	.....
3	8.36	3.23	1.47	2.84	4.03	.90	18	5.45	1.95	2.11	5.52	1.48	.....
4	9.08	3.04	1.70	4.10	3.90	.92	19	5.25	1.92	2.27	5.20	1.44	.....
5	9.66	2.88	1.76	4.80	3.72	1.16	20	5.15	2.00	2.48	5.00	1.40	.....
6	9.30	2.70	1.96	5.14	3.48	1.21	21	5.02	1.82	2.60	4.92	1.36	.....
7	8.80	2.50	1.70	7.34	3.48	1.18	22	4.84	1.70	2.69	4.80	1.40	.....
8	8.31	2.36	1.82	8.26	3.37	1.15	23	.....	1.62	2.51	4.70	1.38	.....
9	7.94	2.18	1.70	8.38	3.14	1.12	24	4.59	1.48	2.41	4.70	1.36	.....
10	7.55	2.06	1.70	8.50	2.81	1.10	25	4.40	1.42	2.28	5.14	1.35	.....
11	7.30	2.02	1.70	8.22	2.42	.....	26	4.20	1.30	2.12	5.08	1.31	.....
12	6.98	1.96	1.66	7.77	2.26	.....	27	4.00	1.39	2.00	.....	1.20	.....
13	6.67	1.98	1.82	7.42	1.98	.....	28	3.86	1.30	2.26	4.60	1.09	.....
14	.....	1.96	1.80	6.92	1.72	.....	29	3.75	1.30	2.36	4.41	1.10	.....
15	6.12	1.86	1.81	6.60	1.68	.....	30	3.52	1.32	2.47	4.39	1.12	.....
							31	.....	1.31	.....	4.34	.93	.....

NOTE.—Gage heights are taken from unpublished records in the United States Engineer Office at St. Paul.

Daily gage height, in feet, of Mississippi River at Anoka, Minn., for 1910.

[B. J. Witte, jr., observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.77	1.05	0.53	0.02	−0.45	−0.30	−0.21	−0.36
2	.....	1.65	1.07	.60	.05	− .50	− .30	− .18	− .30
3	.....	1.40	.95	.57	− .10	− .35	− .30	− .10	− .15
4	.....	1.47	.87	.69	.....	− .48	− .30	.08	− .08
5	.....	1.30	.85	.75	.....	− .40	− .30	.05	− .15
6	.....	1.33	.91	.60	− .35	− .41	− .30	.10	− .18
7	.....	1.45	.87	.39	− .18	− .32	− .30	.08	− .25
8	.....	1.40	.84	.41	− .12	− .50	− .30	.03	− .17
9	.....	1.27	.88	.44	.18	− .50	− .30	.02	− .28
10	.....	1.23	.84	.45	.30	− .52	− .30	− .18	− .25
11	.....	1.30	.65	.25	.52	− .42	− .30	.00	− .35
12	.....	1.23	.74	.13	.52	− .45	− .30	− .12	− .60
13	.....	1.21	.78	.20	.60	− .42	− .30	− .10	− .40
14	1.25	1.23	.81	.11	.48	− .26	− .30	− .18	− .52
15	2.07	.99	.60	.03	− .26	− .32	− .30	− .28	− .65
16	2.25	.90	.59	.07	− .32	− .28	− .35	− .36	− .58
17	2.27	1.05	.80	.04	− .50	− .32	− .20	− .42	− .80
18	2.89	1.10	.68	− .01	− .40	− .26	− .15	− .30	− .85
19	2.87	1.25	.58	− .06	− .48	− .26	− .22	− .40	− .75
20	3.23	1.37	.62	− .10	− .48	− .32	− .16	− .50	.....
21	3.29	1.50	.65	− .09	− .40	− .23	− .25	− .48	− .80
22	3.09	1.55	.65	− .27	− .38	− .35	− .32	− .52	− .85
23	2.90	1.55	.85	− .07	− .39	− .29	− .34	− .52	− .44
24	2.35	1.50	.65	− .10	− .52	− .37	− .34	− .55	− .72
25	2.53	1.56	.57	− .15	− .50	− .25	− .45	− .55	− .80
26	2.51	1.67	.77	− .10	− .61	− .25	− .35	− .50	− .72
27	2.45	1.47	.69	− .06	− .52	− .34	− .38	− .52	− .65
28	2.35	1.40	.69	− .17	− .54	− .22	− .38	− .66	− .62
29	2.15	1.29	.64	− .29	− .35	− .30	− .22	− .70	− .60
30	2.17	1.21	.57	.01	− .48	− .34	− .10	− .66	− .60
31	1.95	.....	.60	.....	− .50	− .32	.....	− .58	.....

NOTE.—Ice present from Jan. 1 to Mar. 13 and from Dec. 1 to 31. Gage heights for Nov. 14 to 30 were affected by backwater.

Daily discharge, in second-feet, of Mississippi River at Anoka, Minn., for 1897 and 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1897.[a]												
1	3,700	2,780	2,880	35,500	17,400	7,310	13,200	20,700	6,340	.....	.....	.....
2	3,740	2,800	2,790	41,300	16,800	8,090	13,600	20,300	6,280	.....	.....	.....
3	3,700	2,820	2,710	42,000	16,100	8,490	14,300	19,900	6,340	.....	.....	.....
4	3,600	2,840	2,780	45,900	15,200	9,430	20,200	19,300	6,410	.....	.....	.....
5	3,500	2,850	2,740	49,100	14,500	9,680	23,600	18,400	7,270	.....	.....	.....
6	3,450	2,700	2,700	47,100	13,700	10,500	25,300	17,300	7,460	.....	.....	.....
7	3,420	2,600	2,720	44,400	12,800	9,430	36,700	17,300	7,340	.....	.....	.....
8	3,390	2,450	2,740	41,800	12,200	9,920	41,500	16,700	7,230	.....	.....	.....
9	2,930	2,300	2,750	39,800	11,400	9,430	42,200	15,700	7,120	.....	.....	.....
10	2,830	2,600	2,740	37,800	10,900	9,430	42,800	14,200	7,040	.....	.....	.....
11	2,720	2,800	2,720	36,500	10,800	9,430	41,300	12,500	.....	.....	.....	.....
12	2,620	3,010	2,540	34,800	10,500	9,270	38,900	11,800	.....	.....	.....	.....
13	2,790	2,950	2,560	33,200	10,600	9,920	37,100	10,600	.....	.....	.....	.....
14	2,810	2,900	2,580	3,180	10,500	9,840	34,500	9,510	.....	.....	.....	.....
15	2,830	2,840	2,610	30,300	10,100	9,880	32,800	9,350	.....	.....	.....	.....
16	2,650	2,790	2,650	29,500	9,920	10,000	30,900	8,690	.....	.....	.....	.....
17	2,610	2,750	2,650	28,400	10,600	10,300	29,500	8,730	.....	.....	.....	.....
18	2,570	2,710	2,650	26,900	10,500	11,100	27,300	8,530	.....	.....	.....	.....
19	2,530	2,800	3,040	25,900	10,300	11,800	25,600	8,370	.....	.....	.....	.....
20	2,490	2,890	3,440	25,400	10,700	12,700	24,600	8,210	.....	.....	.....	.....
21	2,550	2,670	3,850	24,700	9,920	13,200	24,200	8,050	.....	.....	.....	.....
22	2,610	2,450	4,260	23,800	9,430	13,600	23,600	8,210	.....	.....	.....	.....
23	2,670	2,230	4,670	23,200	9,100	12,800	23,200	8,130	.....	.....	.....	.....
24	2,700	2,470	4,090	22,600	8,530	12,400	23,200	8,050	.....	.....	.....	.....
25	2,720	2,720	5,520	21,700	8,290	11,900	25,300	8,010	.....	.....	.....	.....
26	2,730	2,740	6,210	20,700	7,810	11,200	25,000	7,850	.....	.....	.....	.....
27	2,810	2,760	6,900	19,700	8,170	10,700	23,800	7,420	.....	.....	.....	.....
28	2,900	2,820	12,600	19,100	7,810	11,800	22,700	7,000	.....	.....	.....	.....
29	2,980	.....	18,300	18,500	7,810	12,200	21,700	7,040	.....	.....	.....	.....
30	2,900	.....	24,000	17,400	7,890	12,700	21,600	7,120	.....	.....	.....	.....
31	2,840	.....	29,700	.....	7,850	.....	21,400	6,440	.....	.....	.....	.....
1910.[b]												
1	.....	.....	3,800	9,720	6,860	5,280	4,130	3,220	3,490	3,660	3,380	.....
2	.....	.....	3,800	9,220	6,930	5,450	4,190	3,140	3,490	3,720	3,490	.....
3	.....	.....	3,900	8,210	6,510	5,380	3,880	3,400	3,490	3,880	3,780	.....
4	.....	.....	3,900	8,490	6,240	5,690	3,720	3,170	3,490	4,250	3,920	.....
5	.....	.....	4,000	7,810	6,180	5,870	3,560	3,310	3,490	4,190	3,780	.....
6	.....	.....	4,000	7,930	6,370	5,450	3,400	3,290	3,490	4,300	3,720	.....
7	.....	.....	4,200	8,410	6,240	4,940	3,720	3,450	3,490	4,250	3,580	.....
8	.....	.....	4,200	8,210	6,150	4,980	3,840	3,140	3,490	4,150	3,740	.....
9	.....	.....	4,500	7,690	6,280	5,000	4,470	3,140	3,490	4,130	3,530	.....
10	.....	.....	4,500	7,540	6,150	5,080	4,730	3,110	3,490	3,720	3,580	.....
11	.....	.....	5,000	7,810	5,580	4,620	5,250	3,280	3,490	4,080	3,400	.....
12	.....	.....	5,000	7,540	5,840	4,360	5,250	3,220	3,490	3,840	2,980	.....
13	.....	.....	6,000	7,460	5,960	4,510	5,450	3,280	3,490	3,880	3,310	.....
14	.....	.....	7,620	7,540	6,050	4,320	5,150	3,570	3,490	3,720	3,000	.....
15	.....	.....	11,000	6,650	5,450	4,150	3,570	3,450	3,490	3,530	2,900	.....
16	.....	.....	11,700	6,340	5,420	4,230	3,450	3,530	3,400	3,380	2,800	.....
17	.....	.....	11,800	6,860	6,020	4,170	3,140	3,450	3,680	3,280	2,700	.....
18	.....	.....	14,500	7,040	5,670	4,060	3,310	3,570	3,780	3,490	2,600	.....
19	.....	.....	14,400	7,620	5,400	3,960	3,170	3,570	3,640	3,310	2,500	.....
20	.....	.....	16,100	8,090	5,500	3,880	3,170	3,450	3,760	3,140	2,300	.....
21	.....	.....	16,400	8,610	5,580	3,900	3,310	3,620	3,580	3,170	2,250	.....
22	.....	.....	15,400	8,820	5,580	3,550	3,350	3,400	3,450	3,110	2,250	.....
23	.....	.....	14,600	8,820	6,180	3,940	3,330	3,510	3,420	3,110	2,250	.....
24	.....	.....	12,200	8,610	5,580	3,880	3,110	3,360	3,420	3,060	2,250	.....
25	.....	.....	12,900	8,860	5,380	3,780	3,140	3,580	3,220	3,060	2,250	.....
26	.....	.....	12,800	9,310	5,930	3,880	2,960	3,580	3,400	3,140	2,250	.....
27	.....	.....	12,600	8,490	5,690	3,960	3,110	3,420	3,350	3,110	2,250	.....
28	.....	.....	12,200	8,210	5,690	3,740	3,080	3,640	3,350	2,890	2,250	.....
29	.....	.....	11,300	7,770	5,560	3,510	3,400	3,490	3,640	2,830	2,200	.....
30	.....	.....	11,490	7,460	5,380	4,110	3,170	3,420	3,880	2,890	2,200	.....
31	.....	.....	10,500	.....	5,450	.....	3,140	3,450	.....	3,010	.....	.....

[a] Daily discharges computed on a rating curve that is well defined below 25,000 second-feet. Daily discharge from Jan. 1 to Mar. 31 based directly on frequent discharge measurements.

[b] Daily discharges for 1910 based on a well-defined rating curve. November 14 to 30 estimated by comparison with other stations.

Monthly discharge of Mississippi River at Anoka, Minn., for 1897 and 1910.

[Drainage area, 17,100 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1897.						
January	3,740	2,490	2,940	0.172	0.20	
February	3,010	2,230	2,720	.159	.17	
March	29,700	2,540	5,650	.330	.38	
April	49,100	17,400	31,300	1.83	2.04	
May	17,400	7,810	10,900	.637	.73	
June	13,600	7,310	10,600	.620	.69	
July	42,800	13,200	27,500	1.61	1.86	
August	20,700	6,440	11,600	.678	.78	
Sept. 1–10	4,760	6,280	6,880	.402	.15	
1910.						
January			[a] 3,980	.233	.27	C.
February			[a] 3,800	.222	.23	C.
March	16,400		9,230	.540	.62	C.
April	9,720	6,340	8,040	.470	.52	A.
May	6,930	5,380	5,900	.345	.40	A.
June	5,870	3,510	4,460	.261	.29	A.
July	5,450	2,960	3,730	.218	.25	A.
August	3,640	3,110	3,390	.198	.23	A.
September	3,880	3,220	3,510	.205	.23	A.
October	4,300	2,830	3,320	.206	.24	A.
November	3,920	2,200	2,913	.170	.19	A.
December			[b] 1,930	.113	.13	C.
The year	16,400		4,530	.265	3.60	

[a] Estimated from records kept by the St. Anthony Falls Water Power Co., at Minneapolis.
[b] Estimated from United States engineer records at Lock and Dam 2, below Minneapolis.

MISSISSIPPI RIVER AT ST. PAUL, MINN.

This station is located at the upper end of the Diamond Jo Line wharf, at the foot of Jackson Street, St. Paul. At the lower end of the same dock is the United States Engineer Corps gage, the datum of which is 0.5 foot higher than that of the Weather Bureau gage. All data in the following records are referred to the Weather Bureau gage.

The nearest important tributary, Minnesota River, enters several miles above the gaging station.

The flow of the river is controlled to a certain extent by the Government reservoirs on the headwaters, but the effect of these reservoirs is felt very gradually at St. Paul. The nearest dam is at Minneapolis and it is possible that the operation of the wheel gates at that point may cause some daily fluctuations of stage at St. Paul. The Weather Bureau gage is read once a day. The mean gage height for the day may therefore be somewhat in error, although occasional additional readings indicate that the natural storage of the river channel between the two points obviates grave errors.

Previous to 1900 the United States engineer office made many discharge measurements at St. Paul, the results of which are published by the Mississippi River Commission. Although the base data

for computing the daily flow of the river are available prior to 1892, the reservoir system was not in complete operation at that time, and as this system has had a marked influence on the regimen of the river, it is evident that the earlier records have lost much of their value in indicating the probable future flow. Accordingly, no estimates have been made covering periods earlier than 1892. Between 1892 and 1899 the daily discharge for the open season has been computed by means of rating tables based on the United States engineer office measurements and the Weather Bureau gage heights. Between 1899 and 1909 no discharge measurements were made, but measurements made in 1909 and 1910 by the United States Geological Survey indicate that the old rating tables no longer apply. Estimates from 1900 to 1908 have been based on the assumption that the change between the older and later ratings took place uniformly. The 1909 and 1910 estimates are based on the present rating of the station and the Weather Bureau gage heights.

Discharge measurements are made from the Omaha railway bridge 2 miles above the station.

From December to March the river is frozen over and the open-season rating curve does not apply. Computations of monthly flow during this period are based on the records of the St. Anthony Falls Water Power Co., at Minneapolis, and those of the United States Engineer Corps at Lock and Dam 2 below Minneapolis, an allowance being made for the flow of the Minnesota, which enters a few miles above the St. Paul station.

The highest recorded discharge occurred July 22, 1867, and amounted to 117,000 second-feet. Since 1891 the highest discharge was 80,800 second-feet, occurring April 6, 1897. The winter flow has fallen nearly as low as 1,000 second-feet.

Discharge measurements of Mississippi River at St. Paul, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Sept. 4	Gray and Emerson	1,090	4,630	4.45	10,800
22	G. A. Gray	799	2,210	3.35	7,540
1910.					
Mar. 17	Gray and Emerson	1,190	12,100	10.21	32,400
Apr. 9	Emerson and Smith	1,130	5,580	5.66	14,500
May 10	Follansbee and Gray	872	4,030	4.10	9,790
June 8	Adams and Gray	838	3,060	3.02	7,650
27	C. J. Emerson	745	2,210	1.72	4,920
Aug. 4	Follansbee and Gray	370	1,410	.80	4,020
Oct. 27	Adams and Emerson	372	1,360	.82	3,940

Daily gage height, in feet, of Mississippi River at St. Paul, Minn., for 1892–1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1892.[a]												
1				5.0	4.1	11.5	8.4	6.4	3.6	3.0	2.1	
2				5.3	4.4	11.1	7.9	6.2	3.6	3.1	2.1	
3				5.7	4.5	10.8	7.7	6.6	4.0	3.0	2.0	
4				5.7	4.6	10.5	7.4	6.6	3.9	3.0	2.0	
5				5.0	4.6	10.2	7.1	5.8	3.8	2.9	2.0	
6				5.0	5.0	9.0	6.8	5.6	3.7	3.0	2.0	
7			3.9	5.1	5.2	9.7	6.6	5.4	3.7	2.9	2.0	
8			3.2	5.2	5.4	9.4	6.4	5.5	3.6	2.9	2.0	
9			3.0	5.1	5.0	9.8	6.1	5.3	3.6	2.9	2.0	
10			4.4	5.0	6.1	9.1	5.8	5.2	3.6	2.8	2.0	
11			5.0	4.8	6.5	9.6	5.5	5.0	3.7	2.8	1.9	
12			5.0	4.4	6.7	8.7	5.3	4.9	4.0	2.8	1.9	
13			5.0	4.3	6.7	8.7	5.1	4.7	4.0	2.8	2.0	
14			4.3	5.0	6.9	8.7	4.9	4.7	4.1	2.7	2.0	
15			4.2	4.9	7.1	8.6	4.6	4.5	4.0	2.7	1.9	
16			4.0	4.7	7.2	9.0	4.6	4.5	3.8	2.7	1.7	
17			3.8	4.5	7.2	9.5	4.5	4.4	3.6	2.6	1.4	
18			3.4	4.2	7.3	9.5	4.5	4.2	3.5	2.8	1.3	
19			3.4	4.1	7.5	9.7	5.0	4.1	3.3	2.7	1.4	
20			3.3	4.4	9.3	9.7	5.0	4.0	3.2	2.6	1.4	
21			3.0	3.9	10.4	9.8	5.1	3.9	3.2	2.6	1.3	
22			3.1	3.5	11.0	9.7	5.0	3.8	3.2	2.5	1.3	
23			2.9	3.5	11.6	9.5	5.1	3.7	3.1	2.5	1.3	
24			2.7	3.3	12.1	9.1	5.0	3.6	3.1	2.4	1.0	
25			2.8	3.1	12.5	8.9	4.9	3.6	3.0	2.4	1.5	
26			2.0	3.4	12.6	8.7	4.9	3.5	3.0	2.4	2.0	
27			2.2	3.3	12.5	8.7	6.5	3.4	3.0	2.3		
28			2.4	3.3	12.4	8.8	6.7	3.4	2.9	2.3		
29			2.5	3.7	12.2	8.7	6.4	3.3	3.0	2.2		
30			4.0	4.0	11.9	8.6	6.5	3.6	3.1	2.2		
31			4.7		11.8		6.5	3.7		2.2		
1893.[b]												
1				7.3	12.9	9.5	4.2	2.3	2.8	2.8	3.0	1.7
2				8.1	13.7	9.2	4.0	2.3	3.0	2.9	2.6	1.6
3				8.6	14.2	8.9	3.9	2.3	3.0	2.8	2.9	1.8
4				9.4	14.5	8.6	3.9	2.2	2.8	2.7	2.7	1.8
5				10.2	14.7	8.4	4.0	2.2	2.8	2.8	2.6	1.7
6				10.5	14.7	8.1	3.9	2.2	2.9	3.0	2.6	1.9
7				10.6	14.7	8.0	3.7	2.2	2.8	3.1	2.8	1.9
8				10.6	14.6	7.8	3.9	2.2	2.7	3.1	2.8	1.9
9				10.8	14.4	7.5	3.9	2.0	2.7	3.0	2.7	1.9
10				10.9	14.1	7.2	3.8	1.9	2.9	3.0	2.5	2.0
11				10.7	13.7	7.0	3.9	1.8	2.8	2.9	2.4	2.0
12				10.7	13.3	6.8	4.0	1.9	2.9	2.9	2.4	
13				10.6	12.9	6.6	4.0	2.0	2.9	2.9	2.3	
14				10.3	12.7	6.3	4.0	2.1	3.0	2.9	2.3	
15				10.2	12.2	6.1	4.0	2.3	3.0	2.9	2.3	
16				9.9	11.9	5.9	3.9	2.3	3.0	2.9	2.3	
17				9.9	11.7	5.8	3.8	2.3	3.0	3.0	2.1	
18				9.8	11.5	5.6	3.7	2.3	3.0	3.0	2.0	
19				9.6	11.2	5.4	3.6	2.2	3.1	3.0	1.8	
20				9.6	11.0	5.3	3.5	2.2	3.1	3.0	1.3	
21				9.6	10.7	5.2	3.3	2.2	3.0	3.0	1.2	
22				9.4	10.3	5.1	3.2	2.2	2.9	3.0	1.3	
23				9.1	10.0	4.9	3.1	2.2	2.9	3.0	1.2	
24				9.1	9.7	4.8	2.9	2.1	2.9	3.0	1.1	
25				9.2	9.7	4.7	2.8	2.2	2.9	3.0	1.0	
26				9.7	10.0	4.7	2.7	2.0	2.9	2.9	.6	
27				10.5	10.1	4.7	2.7	1.9	2.9	2.9	1.2	
28				11.1	10.2	4.7	2.6	2.0	2.9	2.9	1.8	
29				11.8	10.2	4.5	2.6	2.4	2.8	2.9	1.9	
30				12.4	10.0	4.4	2.3	2.5	2.9	2.9	1.9	
31					9.8		2.4	2.6		3.0		

[a] Ice present from Jan. 1 to Mar. 6 and from Nov. 25 to Dec. 31.
[b] Ice present from Jan. 1 to Mar. 31 and from Dec. 6 to 31.

Daily gage height, in feet, of Mississippi River at St. Paul, Minn., for 1892–1910— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1894.[a]												
1				3.6	9.0	7.1	2.8	0.5	1.6	1.7	2.1	
2				3.4	9.1	6.9	2.8	.4	1.4	2.0	2.1	
3				3.4	9.3	6.6	2.7	.4	1.6	2.0	2.2	
4				2.9	9.4	6.4	2.6	.6	1.6	2.0	2.2	
5				3.0	9.3	6.3	2.5	.4	1.6	2.0	2.2	
6				3.0	9.4	6.1	2.4	.2	1.5	1.9	2.1	
7				2.9	9.3	5.8	2.3	.4	1.6	2.1	2.2	
8			4.3	2.9	9.3	5.6	2.1	.5	1.7	2.1	2.2	
9			4.5	2.9	9.2	5.3	2.0	.3	1.8	2.0	2.1	
10			4.1	3.2	9.2	5.1	2.0	.5	1.8	2.0	2.0	0.9
11			3.9	3.3	9.1	4.9	2.0	1.2	1.7	2.1	1.9	.8
12			3.5	3.5	8.8	4.7	2.0	1.4	1.8	2.2	1.8	.8
13			3.3	3.6	8.4	4.6	1.9	1.7	1.8	2.1	1.9	.8
14			3.4	3.7	8.4	4.4	1.8	1.9	1.8	2.0	1.9	.8
15			3.4	3.8	8.3	4.2	1.8	1.7	1.8	1.9	1.9	
16			3.4	4.1	8.6	4.1	1.7	1.8	1.9	1.8	1.9	
17			3.4	4.6	9.4	4.0	1.5	1.7	1.9	1.8	1.0	
18			3.4	5.4	10.1	3.9	1.5	1.5	1.9	1.6	1.0	.8
19			3.5	6.5	11.3	3.8	1.5	1.7	1.7	1.6	1.1	.8
20			3.8	7.5	11.7	3.7	1.7	1.8	1.6	1.7	1.8	.8
21			4.0	8.5	11.8	3.5	1.6	1.8	1.5	2.0	2.0	.8
22			4.1	9.3	11.7	3.5	1.3	1.9	1.5	1.8	1.8	
23			4.1	10.0	11.3	3.3	1.2	1.9	1.6	1.8	1.2	
24			4.1	10.4	10.7	3.0	1.3	2.0	1.6	1.7	1.2	.6
25			3.3	10.6	10.1	3.0	1.3	1.9	1.7	1.8	1.5	
26			2.7	10.4	9.5	3.0	1.0	1.8	1.7	1.7	1.5	
27			2.3	10.1	8.8	2.9	1.0	1.8	1.5	1.6	1.4	
28			2.0	9.7	8.4	2.9	.9	1.9	1.5	1.6	2.3	
29			3.0	9.3	7.9	2.8	.8	1.5	1.5	1.8	2.6	
30			3.5	9.1	7.6	2.9	.2	1.6	1.6	1.9		
31			4.0		7.4		.6	1.7		2.1		
1895.[b]												
1				1.0	.7	1.8	3.7	1.4	1.8	2.4	1.4	
2				1.0	.8	2.0	3.8	1.3	1.5	2.1	1.2	
3				1.0	.9	2.8	3.7	1.0	1.7	2.2	1.2	
4				.9	1.1	2.7	3.4	1.0	1.7	2.2	1.2	
5				1.0	1.3	2.6	3.1	.9	1.8	2.1	1.4	
6				1.0	1.4	2.9	3.1	1.1	1.8	2.2	1.5	
7				1.0	1.9	2.8	3.0	.8	1.9	2.1	1.2	
8				.9	2.0	2.9	3.0	.9	2.0	2.2	1.4	
9				1.0	2.1	3.0	3.1	1.0	1.9	2.2	1.5	
10				.8	2.1	3.1	3.1	1.3	2.0	2.1	1.4	
11				1.0	2.5	3.9	2.8	1.6	2.0	2.1	1.3	
12				1.2	2.3	4.1	2.7	1.7	2.0	2.1	1.5	
13				1.0	2.3	4.1	2.6	1.8	2.0	1.9	1.4	
14				1.0	2.2	4.4	2.4	1.9	1.9	1.7	1.4	
15				.9	2.0	4.5	2.5	2.3	1.7	1.9	1.5	
16				.9	2.2	4.6	2.4	2.0	1.5	1.8	1.5	
17				.8	2.0	4.6	2.3	2.0	1.9	1.9	1.4	
18				.8	2.0	4.5	2.6	2.2	1.7	1.8	1.3	
19				.7	1.8	4.3	2.5	2.0	1.8	1.7	1.4	
20				.7	1.5	4.0	2.3	2.2	1.8	1.7	1.5	
21				.7	1.8	3.8	2.1	2.0	1.9	1.5	.9	
22			.2	.8	1.7	3.7	1.9	1.8	2.1	1.7	.6	
23			.3	.9	1.5	3.6	1.9	1.7	2.3	1.5	.6	
24			.5	.6	1.5	3.5	1.8	1.8	2.5	1.6	.5	
25			.6	.5	1.5	3.4	1.8	1.8	2.4	1.5	.6	
26			.6	.6	1.6	3.4	1.8	1.7	2.3	1.5	.6	
27			1.0	.9	1.5	3.4	1.8	1.9	2.2	1.4	.9	
28			1.4	.6	1.7	3.5	1.7	1.8	2.2	1.2		
29			1.3	.3	1.8	3.6	1.5	1.8	2.2	1.5		
30			1.3	.9	1.8	3.7	1.8	1.7	2.1	1.4		
31			1.3		1.7		1.5	1.7		1.4		

[a] Ice present from Jan. 1 to Mar. 7 and from Nov. 28 to Dec. 9 and Dec. 25 to 31.
[b] Ice present from Jan. 1 to Mar. 21 and from Nov. 27 to Dec. 31

Daily gage height, in feet, of Mississippi River at St. Paul, Minn., for 1892–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1896.[a]												
1				0.7	7.9	9.1	5.7	1.9	2.1	2.1	2.5	
2				.0	8.3	8.7	5.4	1.8	1.8	2.1	2.5	
3				−.1	8.6	8.5	5.3	1.8	1.7	2.0	2.9	
4				.4	8.9	8.1	5.2	2.1	1.4	2.1	2.8	
5				1.0	9.1	8.0	5.1	1.7	1.4	1.9	2.8	
6				1.4	9.2	7.6	4.8	1.7	1.3	2.2	2.8	
7				1.7	9.3	8.0	4.7	1.8	1.4	1.9	2.9	
8				1.8	9.1	8.1	4.6	2.1	1.6	1.8	3.0	
9				1.8	9.0	8.3	4.3	2.0	1.7	1.8	2.9	
10			−0.2	1.8	8.8	8.6	4.2	2.0	1.9	1.9	2.9	
11			− .4	2.1	8.7	8.8	4.1	2.2	2.0	1.9	2.6	
12			− .3	2.7	8.4	8.9	4.1	2.3	1.9	2.1	2.2	
13			− .2	3.9	8.4	8.9	4.0	2.5	1.8	2.2	1.9	
14			0	7.0	8.4	8.7	3.9	2.6	1.8	2.2	2.0	
15			.0	8.3	8.5	8.4	3.8	2.6	1.9	2.3	2.1	
16			− .5	9.5	8.6	8.0	3.5	2.5	2.2	2.2	1.8	
17			− .2	10.5	9.2	7.6	3.2	2.4	2.3	2.2	2.0	
18			− .4	10.7	9.6	7.2	3.0	2.3	2.3	2.1	2.0	
19			− .9	10.4	10.0	6.9	2.9	2.2	2.3	2.1	2.0	
20			− .9	9.9	10.3	6.7	2.8	2.1	2.2	2.2	1.6	
21			− .8	9.5	10.5	6.5	2.9	2.1	2.1	2.2	1.5	
22			− .9	9.0	10.5	6.1	2.7	2.0	2.0	2.1	1.8	
23			− .8	8.6	10.4	6.2	2.7	2.1	2.0	2.0	3.7	
24			− .4	8.3	10.2	6.4	2.6	2.1	2.0	2.0	2.7	
25			− .4	7.8	10.0	6.6	2.6	2.2	1.9	2.1	3.0	
26			− .2	7.6	9.7	6.7	2.5	2.0	2.0	2.0	3.3	
27			− .2	7.4	9.5	6.8	2.4	2.0	2.1	1.9	3.5	
28			− .1	7.1	9.5	6.6	2.1	2.0	2.1	2.0		
29			.1	7.2	9.5	6.2	2.0	1.9	2.1	1.9		
30			.2	7.5	9.5	6.0	1.9	1.8	2.0	2.3		
31			.7		9.3		1.8	1.9		2.5		
1897.[b]												
1				15.3	10.0	5.2	6.5	8.9	4.5	4.9	3.8	
2				16.4	9.8	5.5	6.6	8.7	4.5	4.8	3.9	
3				17.1	9.6	5.5	6.7	8.6	4.6	4.7	3.9	3.2
4				17.4	9.1	5.5	6.8	8.4	4.6	4.5	3.9	
5				17.9	8.8	5.7	7.9	8.2	4.6	4.6	3.8	
6				18.0	8.5	5.8	8.9	8.0	4.7	4.5	3.8	
7				17.8	8.2	5.9	9.9	7.7	4.7	4.5	3.8	
8				17.7	7.9	6.0	12.0	7.8	4.6	4.4	3.8	
9				17.8	7.6	5.9	13.0	7.6	4.6	4.4	3.8	
10				17.7	7.3	5.9	13.3	7.2	4.5	4.3	3.7	4.1
11				17.5	7.1	6.0	13.6	6.9	4.5	4.1	3.6	
12				17.1	7.0	5.9	13.5	6.6	4.5	4.2	3.6	
13				16.6	6.8	5.7	13.3	6.3	4.6	4.2	3.6	
14				16.2	6.7	5.8	13.0	6.0	4.9	4.1	3.6	
15				15.7	6.6	5.8	12.6	5.8	5.1	4.0	3.6	
16				15.2	6.5	5.9	13.3	5.6	5.2	4.0	3.6	
17				14.9	6.4	5.9	11.8	5.5	5.5	4.0	3.5	4.0
18				14.6	6.4	6.0	11.3	5.4	5.5	3.9	3.5	
19				14.0	6.4	6.2	10.8	5.4	5.5	4.0	3.4	
20				13.7	6.4	6.4	10.4	5.3	5.4	4.1	3.3	
21			4.9	13.3	6.4	6.6	10.2	5.2	5.3	4.1	3.2	
22			5.5	13.0	6.2	6.7	9.9	5.2	5.4	4.1	3.2	
23			6.5	12.8	6.0	6.8	9.7	5.1	5.4	4.1	2.9	
24			7.6	12.4	5.8	6.7	9.6	5.0	5.3	4.2	2.6	3.9
25			8.4	12.1	5.7	6.6	9.5	5.0	5.2	4.1	2.5	
26			9.1	11.7	5.6	6.3	9.8	5.0	5.0	4.1	2.4	
27			9.5	11.4	5.6	6.1	9.8	4.8	5.0	4.0	2.3	
28			9.9	11.0	5.5	6.1	9.6	4.7	5.0	3.9		
29			10.1	10.6	5.4	6.2	9.4	4.6	5.0	3.9		
30			12.2	10.3	5.3	6.4	9.1	4.5	4.9	3.8		
31			13.5		5.3		9.0	4.5		3.8		3.5

[a] Ice from Jan. 1 to Mar. 9 and from Nov. 23 to Dec. 31.
[b] Ice from Jan. 1 to Mar. 20 and from Nov. 28 to Dec. 31.

Daily gage height, in feet, of Mississippi River at St. Paul, Minn., for 1892–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1898.[a]												
1				3.8	3.2	5.2	4.8	3.8	3.2	3.1	3.9	
2				3.6	3.3	5.2	5.0	3.8	3.1	2.9	3.9	
3				3.6	3.4	5.2	4.9	3.6	2.9	2.8	3.8	
4				3.6	3.4	5.0	4.9	3.5	2.8	2.8	3.8	
5				3.8	3.6	5.1	5.0	3.3	2.8	2.8	3.8	
6				3.9	3.6	8.9	5.2	3.8	2.8	2.9	3.7	
7				3.9	3.7	10.3	5.5	3.4	2.8	3.1	3.5	
8			3.7	3.9	3.6	10.7	5.6	3.4	2.7	3.2	3.5	
9			3.8	3.9	3.4	10.7	5.7	3.3	2.7	3.2	3.5	
10			4.1	3.8	3.4	10.5	6.1	3.2	2.7	3.3	3.4	
11			4.2	3.8	3.1	10.2	6.4	3.0	2.9	3.6	3.4	
12			4.1	4.0	3.1	9.9	6.7	3.0	2.8	3.5	3.3	
13			3.6	4.0	2.9	9.6	6.9	3.0	2.8	3.8	3.3	
14			3.1	3.9	2.9	9.4	6.6	2.8	3.0	4.0	3.1	
15			4.2	4.1	3.1	9.0	6.2	2.7	3.1	4.0	3.1	
16			3.9	4.1	3.0	8.4	5.9	3.0	3.1	4.1	3.1	
17			3.8	4.0	3.0	7.9	5.5	2.8	3.0	4.1	3.1	
18			3.7	3.9	3.0	7.5	5.3	2.8	3.0	4.2	3.1	
19			4.0	3.9	3.1	7.2	5.1	2.8	2.8	4.2	3.1	
20			3.9	3.9	3.2	6.9	5.0	2.7	2.8	4.3	3.2	
21			3.8	3.8	3.3	6.6	4.8	2.8	2.8	4.4	3.1	
22			3.8	3.7	3.8	6.4	4.6	2.8	2.8	4.5	3.1	
23			3.7	3.5	4.0	6.3	4.4	2.8	2.9	4.6		
24			3.0	3.4	4.3	6.0	4.3	2.9	2.9	4.6		
25			3.4	3.1	4.6	5.7	4.2	3.0	3.1	4.6		
26			3.8	3.2	4.7	5.3	4.2	3.0	3.1	4.5		
27			3.9	3.0	4.5	5.1	4.2	3.0	3.1	4.5		
28			3.6	3.0	4.7	5.0	4.0	3.1	3.1	4.4		
29			2.8	3.0	4.8	4.8	3.9	3.2	3.1	4.2		
30			2.8	3.0	5.0	4.7	3.9	3.3	3.2	4.1		
31			3.4		5.0		4.0	3.3		4.0		
1899.[b]												
1					6.4	5.7	8.7	4.0	7.5	4.4	7.2	4.7
2					6.6	6.6	8.7	3.8	7.2	4.3	7.1	4.7
3					6.8	7.7	8.5	3.7	6.9	4.2	7.0	4.6
4					7.0	8.2	8.3	3.7	6.7	4.2	6.8	4.5
5					7.1	8.5	8.0	3.6	6.4	4.2	6.7	4.2
6					7.2	8.7	7.8	3.5	6.2	4.1	6.6	3.2
7					7.5	9.2	7.5	3.5	6.2	4.1	6.5	2.5
8				5.0	7.6	9.6	7.3	3.5	6.1	4.1	6.4	2.5
9				6.9	7.5	9.7	7.0	3.5	5.9	4.0	6.2	3.2
10				7.4	7.2	9.8	6.8	3.7	5.8	4.0	6.1	4.2
11				7.5	6.9	9.9	6.5	3.9	5.7	4.0	6.0	4.6
12				8.1	6.7	9.7	6.2	4.0	5.7	4.1	6.0	4.4
13				9.8	6.5	9.9	6.0	4.1	5.7	4.1	5.9	
14				10.5	6.2	10.0	5.9	3.8	5.6	4.3	5.8	
15				10.3	6.1	10.3	5.9	3.8	5.6	4.4	5.7	
16				10.4	6.0	10.5	6.0	3.8	5.6	4.6	5.6	
17				10.4	6.1	10.6	5.7	4.0	5.3	5.3	5.5	
18				10.4	6.1	10.8	5.4	4.0	5.2	5.8	5.4	
19				10.1	6.0	10.9	5.2	4.0	5.1	6.7	5.4	
20				9.5	5.9	10.9	5.1	4.3	5.0	7.5	5.3	
21				8.8	5.9	10.9	5.0	4.6	5.0	8.0	5.2	
22				8.0	5.9	11.0	5.0	5.8	5.0	8.4	5.1	
23				7.4	5.9	11.0	5.0	6.6	5.0	8.7	5.0	
24				7.0	5.8	10.9	4.8	8.0	5.0	8.8	5.0	
25				6.7	5.8	10.7	4.7	8.7	4.9	8.7	5.0	
26				6.5	5.8	10.3	4.6	8.8	4.9	8.6	5.0	
27				6.3	5.7	9.9	4.5	8.7	4.8	8.2	4.9	
28				6.1	5.8	9.5	4.3	8.5	4.8	8.0	4.9	
29				6.1	5.8	9.2	4.2	8.3	4.7	7.8	4.8	
30				6.2	5.7	8.8	4.1	8.0	4.5	7.6	4.8	
31					5.7		4.0	7.7		7.4		

[a] Ice from Jan. 1 to Mar. 7 and from Nov. 23 to Dec. 31.
[b] Ice from Jan. 1 to Apr. 7 and from Dec. 10 to 31.

Daily gage height, in feet, of Mississippi River at St. Paul, Minn., for 1892–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1900.[a]												
1				3.4	3.7	3.2	0.8	1.1	5.4	5.8	4.5	2.0
2				3.0	3.7	3.0	.7	1.2	5.3	5.8	4.5	2.0
3				3.2	3.8	2.9	1.0	1.2	5.0	5.9	4.5	2.0
4				3.7	3.8	2.7	2.0	1.2	4.8	5.9	4.5	2.2
5				3.8	3.8	2.6	2.6	1.0	4.7	6.3	4.6	2.3
6				4.6	3.7	2.5	2.9	1.0	4.5	6.5	4.6	2.3
7				5.6	3.5	2.5	2.9	1.0	4.2	6.6	4.6	2.2
8				5.6	3.4	2.4	3.0	1.1	4.0	6.3	4.5	1.9
9				5.2	3.3	2.4	2.9	1.2	3.9	6.2	4.4	1.9
10				5.0	3.5	2.4	2.9	1.5	4.2	6.0	4.3	1.8
11				4.8	3.2	1.8	2.8	2.2	4.4	5.9	4.2	2.4
12				4.5	3.0	1.8	2.8	2.8	5.3	5.8	4.1	3.6
13				4.3	2.9	1.9	3.0	2.9	5.8	5.7	4.0	3.5
14				4.2	2.8	1.9	3.0	3.5	5.7	5.7	3.8	2.8
15				4.1	2.8	1.5	2.8	3.7	5.5	5.4	3.5	1.8
16				4.0	2.8	1.5	2.8	4.0	5.3	5.3	2.7	2.6
17				4.4	2.8	1.4	2.6	4.2	5.2	5.3	2.1	2.4
18				4.6	2.9	1.3	2.5	4.3	5.1	5.3	2.0	2.7
19				4.8	2.9	1.3	2.3	4.2	5.0	5.2	2.0	3.3
20				4.6	2.6	1.2	2.2	4.0	5.2	5.1	2.1	3.0
21				4.4	2.5	1.2	2.2	3.8	5.5	5.0	2.1	2.7
22				4.2	2.7	1.2	2.2	3.7	5.7	4.8	2.1	2.4
23				4.0	2.8	1.2	2.2	3.7	5.9	4.8	2.0	2.3
24				4.0	2.8	1.2	2.1	3.9	5.9	4.6	1.9	2.2
25				4.0	2.8	1.0	1.8	4.1	6.0	4.5	1.6	.....
26				3.9	2.7	1.0	1.5	4.5	6.0	4.5	1.3	.....
27				3.8	2.8	1.0	1.1	4.7	6.0	4.3	1.8	.....
28				3.8	2.8	.9	1.1	5.0	6.0	4.5	2.1	.....
29				3.8	3.2	.9	1.3	5.4	5.9	4.6	2.0	.....
30				3.7	3.3	.8	1.0	5.5	5.8	4.5	2.0	.....
31				.....	3.3	.....	1.0	5.4	.....	4.3	.....	.....
1901.[b]												
1				5.4	6.0	5.0	6.0	3.8	2.6	2.6	2.7	2.0
2				5.6	6.0	4.9	6.3	3.7	2.8	2.6	2.7	2.1
3				5.6	6.1	4.8	6.4	3.4	2.7	2.6	2.8	1.8
4				5.8	6.1	4.8	6.5	3.3	2.7	2.7	2.7	.....
5				6.1	6.8	4.7	6.5	3.1	2.6	2.7	2.7	.....
6				6.5	6.9	4.7	6.6	3.0	2.6	2.6	2.7	.....
7				6.4	7.1	4.5	6.7	3.0	2.6	2.4	2.6	.....
8				6.5	7.2	4.3	6.9	2.9	2.5	2.4	2.6	.....
9				6.8	7.3	4.2	7.0	2.8	2.4	2.4	2.5	.....
10				7.2	7.3	4.1	7.1	2.7	2.5	2.4	2.5	.....
11				7.3	7.3	4.2	7.2	2.6	2.6	2.5	2.5	.....
12				7.5	7.1	4.3	7.2	2.4	2.7	2.6	2.6	.....
13				7.2	7.0	4.3	7.2	2.3	2.5	2.6	2.5	.....
14				6.7	7.0	4.1	7.0	2.5	2.5	2.7	2.5	.....
15				6.5	6.9	4.3	6.9	2.7	2.4	2.9	2.5	.....
16				6.5	6.8	4.3	6.8	2.9	2.3	3.1	2.4	.....
17				6.7	6.7	4.1	6.7	2.9	2.3	3.0	1.9	.....
18				6.6	6.7	4.0	6.6	2.8	2.2	3.0	1.5	.....
19				6.6	6.6	4.0	6.4	2.7	2.1	2.9	1.6	.....
20				6.6	6.5	4.2	6.1	2.6	2.1	2.9	1.6	.....
21				6.5	6.4	4.4	5.8	2.6	2.1	2.9	1.6	.....
22				6.5	6.2	5.0	5.5	2.6	2.0	2.8	1.6	.....
23				6.5	6.2	5.5	5.3	2.5	2.0	2.8	1.7	.....
24				6.4	6.1	5.6	5.0	2.5	2.0	2.7	1.7	.....
25			5.4	6.4	5.9	5.7	4.8	2.5	2.1	2.7	1.3	.....
26			5.8	6.3	5.8	5.7	4.5	2.4	2.2	2.6	1.6	.....
27			5.7	6.3	5.6	5.7	4.3	2.5	2.3	2.6	1.5	.....
28			5.4	6.3	5.4	5.6	4.1	2.6	2.4	2.6	1.4	.....
29			5.2	6.2	5.3	6.1	4.0	2.6	2.5	2.6	1.3	.....
30			5.3	6.1	5.2	6.2	3.9	2.6	2.4	2.7	1.5	.....
31			5.3	.....	5.1	.....	3.9	2.6	.....	2.7	.....	.....

[a] Ice from Jan. 1 to Mar. 31 approximately and from Dec. 4 to 31.
[b] Ice from Jan. 1 to Mar. 24 and from Dec. 1 to 31.

Daily gage height, in feet, of Mississippi River at St. Paul, Minn., for 1892–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902.[a]												
1				2.1	1.9	6.3	4.7	3.4	1.5	1.9	2.4	3.4
2				2.1	2.0	6.1	4.6	3.1	1.6	2.0	2.4	3.1
3				2.2	1.9	6.0	4.4	2.9	2.0	2.0	2.5	3.0
4				2.2	2.1	6.1	4.3	2.6	2.4	2.1	2.6	
5				2.1	2.1	6.4	4.2	2.6	2.7	2.1	2.7	
6				2.0	2.2	6.6	4.2	2.3	2.9	2.1	3.0	
7				1.8	2.2	6.7	4.0	2.	3.1	2.2	3.2	
8				1.8	2.3	6.7	3.9	2.4	2.9	2.2	3.4	
9				1.9	2.4	6.8	3.9	2.4	3.0	2.2	3.5	
10			1.1	2.0	2.8	6.8	4.1	2.8	3.0	2.2	3.5	
11			1.2	1.9	4.1	6.7	4.3	2.4	2.9	2.2	3.5	
12			1.2	1.8	4.3	6.7	4.3	2.2	2.7	2.2	3.5	
13			1.2	1.7	4.5	6.7	4.3	2.2	2.5	2.0	3.6	
14			1.5	1.7	4.4	6.6	4.1	2.1	2.2	2.0	3.6	
15			1.8	1.6	4.3	6.4	3.9	2.1	2.0	2.0	3.6	
16			2.1	1.6	4.2	6.2	3.8	2.0	2.1	1.9	3.6	
17				1.7	4.2	6.1	4.0	2.0	2.2	1.9	3.7	
18				1.5	4.3	6.0	3.8	1.8	2.2	1.8	3.9	
19			1.5	1.4	4.3	5.8	3.5	1.7	2.1	1.8	4.1	
20			1.9	1.3	4.4	5.6	3.4	1.7	2.0	1.7	4.3	
21			2.1	1.2	4.4	5.5	3.0	1.6	2.2	1.7	4.5	
22			2.2	1.3	4.5	5.4	2.8	1.8	2.1	1.8	4.5	
23			2.2	1.3	5.6	5.2	2.6	1.8	2.2	1.8	4.6	
24			2.3	1.2	6.9	5.1	2.5	1.8	2.2	1.8	4.5	
25			2.6	1.2	7.4	5.1	2.5	1.5	2.1	1.8	4.5	
26			2.7	1.7	7.5	4.9	2.7	1.6	2.0	1.8	4.4	
27			2.8	1.8	7.5	4.8	2.8	1.6	2.0	1.8	4.4	
28			2.6	1.7	7.3	4.8	2.8	1.5	1.9	1.9	4.2	
29			2.4	1.7	7.0	4.8	2.9	1.4	1.8	2.1	3.8	
30			2.3	1.8	6.7	4.7	3.3	1.4	1.8	2.3	3.6	
31			2.1		6.5		3.4	1.4		2.3		
1903.[b]												
1				7.5	6.9	10.5	3.2	5.3	3.8	8.8	7.1	5.0
2				7.1	6.9	11.3	3.2	5.5	3.8	8.3	6.8	5.5
3			2.8	7.0	6.8	11.9	3.5	5.7	3.9	8.6	6.5	5.6
4		2.5		7.0	6.8	11.9	4.5	6.0	4.0	8.0	6.2	5.6
5				7.0	6.8	11.5	5.9	6.1	4.2	8.0	6.1	5.3
6				6.9	6.9	10.8	6.4	6.2	4.2	8.3	6.1	5.4
7				7.2	7.0	10.2	6.7	6.2	4.2	9.5	6.1	5.2
8	2.9		3.6	7.2	7.1	9.5	6.7	6.3	4.3	10.8	6.0	5.0
9				7.1	7.2	8.9	6.7	6.2	4.4	11.6	6.0	4.8
10				6.9	7.1	8.3	7.0	6.0	4.4	12.2	5.8	
11			4.2	7.1	7.1	7.6	7.3	5.8	4.3	12.7	5.5	
12				7.4	7.6	6.8	7.6	5.6	4.6	13.0	5.4	
13				7.8	8.3	6.0	7.7	5.3	7.3	13.3	5.4	
14		2.6	5.6	8.1	9.0	5.5	7.5	5.1	8.6	13.5	5.4	
15			6.0	8.4	9.6	5.4	7.2	5.0	9.4	13.4	5.4	
16			6.1	8.6	10.1	5.3	7.0	4.9	10.0	13.1	5.3	4.4
17	2.7		6.3	8.8	10.4	5.1	7.0	4.8	10.5	12.8	5.2	
18			6.2	8.9	10.8	4.8	7.0	4.8	10.8	12.5	5.0	
19			6.3	8.8	10.9	4.6	6.5	4.8	11.1	12.1	4.6	
20			7.1	8.7	10.8	4.5	6.2	4.8	11.5	11.6	3.8	
21		2.8	7.4	8.5	10.6	4.4	6.0	4.8	11.7	11.1	3.2	
22			7.7	8.2	10.4	4.3	5.9	4.8	11.9	10.7	3.0	
23			7.7	7.9	10.1	4.2	5.9	4.6	11.9	10.2	3.0	
24	2.6		7.9	7.8	9.6	4.1	5.8	4.5	11.9	9.8	3.3	
25			8.1	7.5	9.4	3.9	5.7	4.3	11.7	9.4	3.6	3.8
26			8.3	7.3	9.3	3.8	5.4	4.1	11.3	9.0	4.6	
27			8.3	7.2	9.3	3.7	5.4	3.9	10.9	8.6	4.6	
28		3.0	8.3	7.2	9.5	3.6	5.2	3.8	10.4	8.3	5.2	
29			8.1	7.1	9.5	3.6	5.1	4.0	9.9	8.0	5.5	
30	2.5		7.8	7.1	9.5	3.4	5.1	4.1	9.3	7.6	5.0	
31			7.7		9.8		5.2	3.9		7.3		3.6

[a] Ice from Jan. 1 to Mar. 9 and from Dec. 4 to 31.
[b] Ice from Jan. 1 to Mar. 14 and from Dec. 1 to 31.

Daily gage height, in feet, of Mississippi River at St. Paul, Minn., for 1892–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904.[a]												
1				5.8	8.3	5.7	5.2	3.5	2.9	3.2	6.5	3.2
2				5.6	8.2	5.6	5.2	3.5	2.8	3.5	6.2	3.0
3			3.2	5.5	8.0	5.7	5.1	3.4	3.6	3.6	5.9	2.8
4				5.8	7.8	5.9	5.1	3.3	4.2	3.7	5.6	2.7
5		3.0		6.2	7.5	6.2	5.0	3.2	4.4	3.5	5.5	2.6
6	3.1			6.5	7.4	6.3	4.9	3.2	4.6	3.4	5.4	2.6
7				8.4	7.4	6.8	4.8	3.1	5.1	3.4	5.4	2.7
8			3.2	8.8	7.5	7.2	4.8	2.9	5.2	3.6	5.3	3.0
9				9.0	7.4	7.5	4.8	2.9	5.2	3.7	5.0	3.2
10				9.7	7.3	7.7	5.0	3.0	5.2	4.0	4.7	3.5
11				9.9	7.2	7.8	4.9	3.0	5.2	4.2	4.8	3.7
12		3.1		9.9	7.4	7.7	4.7	3.0	5.0	5.8	4.8	3.7
13				9.8	7.5	7.6	4.5	3.0	4.7	6.0	4.6	
14	3.2			9.6	7.4	7.5	4.4	3.0	4.3	6.0	4.5	
15				9.4	7.3	7.3	4.2	3.0	3.9	6.4	4.5	
16			3.5	9.4	7.2	6.9	4.1	2.9	3.8	6.7	4.4	
17				9.2	7.0	6.6	4.0	2.8	3.7	6.9	4.3	
18				8.9	6.8	6.3	3.9	2.7	3.6	6.8	4.1	
19		3.0		8.7	6.7	5.9	3.9	2.6	3.4	6.8	4.1	
20				8.5	6.6	5.6	3.9	2.9	3.3	7.0	4.0	
21				8.4	6.4	5.4	3.8	3.1	3.1	7.1	3.9	
22	3.1		4.5	8.2	6.3	5.3	3.7	3.2	3.0	7.5	3.9	
23				8.2	6.2	5.1	3.8	3.5	2.9	7.7	3.8	
24				8.1	6.1	5.0	3.8	3.7	2.9	7.5	3.8	
25				8.1	6.1	5.0	3.7	3.8	2.9	7.6	3.8	
26		3.2	5.6	8.1	6.1	4.9	3.6	3.7	2.8	7.7	3.8	
27				8.4	6.1	5.0	3.5	3.8	2.8	7.8	3.7	
28				8.5	6.2	5.1	3.4	3.8	3.0	7.8	3.7	
29			5.7	8.6	6.2	5.3	3.3	3.8	3.0	7.5	3.6	
30	3.0		5.6	8.5	6.0	5.2	3.4	3.5	2.9	7.2	3.4	
21			6.0		5.8		3.5	3.2		6.8		
1905.[b]												
1				4.8	3.8	7.6	11.6	7.8	6.3	5.9	5.4	
2				4.8	3.7	7.1	11.5	7.5	6.1	5.8	5.3	
3	2.8			4.8	3.7	6.9	11.6	7.3	6.1	5.6	5.2	
4				4.9	3.8	6.9	11.7	7.2	6.0	5.6	5.2	
5				5.4	4.2	7.0	12.0	7.2	6.0	5.6	5.1	6.0
6				5.2	4.8	7.0	12.5	7.3	5.9	5.5	5.2	
7		2.1	5.4	5.8	6.2	7.4	13.1	7.0	5.9	5.5	5.4	
8			5.1	6.4	7.0	7.9	13.8	7.0	5.8	5.4	5.4	
9	2.4		4.9	6.6	6.8	8.1	14.3	7.0	5.8	5.3	5.5	
10			5.5	6.7	6.8	8.1	14.6	7.0	5.8	5.3	5.6	6.4
11			4.8	6.7	7.2	8.4	14.8	7.1	5.6	5.2	5.5	6.5
12			4.0	6.7	8.0	8.4	14.7	7.1	5.6	5.2	5.6	6.6
13			3.7	6.3	8.7	8.3	14.5	7.0	5.5	5.1	5.4	6.4
14		2.0	3.5	6.1	8.9	8.3	14.3	7.0	5.4	5.0	5.4	6.5
15			3.4	5.8	10.0	8.1	14.0	7.0	5.7	5.0	5.3	7.1
16	2.4		3.5	5.7	10.8	8.0	13.7	7.0	5.7	4.9	5.2	7.6
17			3.5	5.2	11.2	8.5	13.2	7.1	5.8	4.8	5.1	7.4
18			3.5	5.1	11.7	8.9	12.7	7.9	5.7	5.1	5.0	7.3
19			3.4	4.9	11.7	9.5	12.3	8.0	6.5	5.3	5.0	6.9
20			3.4	4.8	11.6	10.1	11.8	8.0	7.0	5.4	4.9	6.8
21		2.0	3.8	4.7	11.5	10.4	11.4	8.2	7.4	5.6	4.9	6.6
22			4.2	4.5	11.2	10.5	11.1	7.9	7.3	5.7	4.8	6.4
23	2.5		4.8	4.4	11.0	10.4	10.7	7.8	7.2	5.9	4.8	6.3
24			5.2	4.2	10.8	10.3	10.4	7.6	7.0	5.9	4.8	7.0
25			5.3	4.0	10.6	10.3	10.1	7.5	6.9	5.9	5.0	8.2
26			5.4	3.9	10.3	10.4	9.8	7.5	6.7	6.0	5.3	9.2
27		2.5	5.6	3.9	9.9	10.7	9.5	7.2	6.5	5.9	5.4	8.0
28			5.9	3.8	9.4	11.1	9.4	6.9	6.3	5.8	5.6	7.8
29			5.4	3.8	9.0	11.4	9.0	6.7	6.2	5.7	5.9	7.3
30	2.3		5.0	3.8	8.6	11.6	8.7	6.6	6.0	5.7		7.1
31			4.8		8.1		8.2	6.4		5.6		

[a] Ice from Jan. 1 to Mar. 31 and from Dec. 1 to 31.
[b] Ice from Jan. 1 to Mar. 6 and from Nov. 30 to Dec. 31.

Daily gage height, in feet, of Mississippi River at St. Paul, Minn., for 1892–1910— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906.[a]												
1				7.5	9.0	12.0	10.3	6.0	8.4	8.0	7.8	6.4
2				7.2	8.8	12.0	10.3	5.9	8.4	7.9	7.9	6.0
3				7.8	8.9	12.0	10.4	5.8	8.2	7.7	7.9	5.5
4				8.3	8.9	11.8	10.5	5.6	8.0	7.6	7.8	5.1
5				9.0	8.8	11.7	10.5	5.5	7.8	7.4	7.7	5.1
6				10.0	8.8	11.8	10.6	5.4	7.6	7.2	7.6	5.1
7		5.2		10.2	8.6	12.1	10.4	5.4	7.4	7.0	7.6	.....
8	6.7			11.0	8.4	12.3	10.2	5.3	7.2	6.8	7.6	.....
9			6.1	11.4	8.4	12.5	10.0	5.7	7.0	6.6	7.6	.....
10				11.2	8.4	12.7	9.8	6.4	6.8	6.3	7.6	.....
11				10.9	8.2	13.1	9.5	6.7	6.7	6.2	7.5	.....
12				10.9	8.0	13.3	9.2	6.8	6.5	6.1	7.4	5.5
13				10.8	8.1	13.2	9.0	6.7	6.5	5.9	7.3	.....
14	6.8	5.4		10.9	8.0	13.0	8.6	6.7	6.4	5.8	7.2	5.5
15				11.2	7.9	12.6	8.3	6.7	6.3	5.6	7.0	5.4
16				11.5	7.8	12.2	8.0	6.8	6.3	5.5	6.9	6.6
17			6.0	11.8	7.7	11.8	7.8	6.9	6.2	5.4	6.9	.....
18				11.9	7.6	11.3	7.5	6.9	6.2	5.2	7.0	.....
19				12.0	7.5	10.9	7.3	6.8	6.2	5.1	6.5	7.3
20				11.9	7.5	10.6	7.1	6.7	6.2	5.1	6.2	.....
21		5.5		11.8	7.7	10.6	6.9	6.5	6.5	5.1	5.7	.....
22				11.5	8.4	10.5	6.8	6.3	6.6	5.0	5.5	.....
23				11.2	9.0	10.4	6.6	6.5	7.0	5.0	5.2	.....
24	5.4		6.1	10.9	9.8	10.3	6.5	6.7	7.2	5.2	5.2	.....
25				10.6	10.0	10.2	6.2	6.8	7.6	5.6	5.0	.....
26				10.3	10.3	10.2	6.1	7.2	8.0	6.1	5.7	6.2
27				10.0	10.8	10.1	5.9	7.6	8.2	6.6	5.9	.....
28		5.7		9.6	11.2	10.2	6.0	7.9	8.3	6.9	6.1	.....
29				9.4	11.6	10.2	6.2	8.1	8.2	7.1	6.2	.....
30	5.8		6.8	9.1	11.8	10.3	6.1	8.3	8.1	7.5	6.3	.....
31				.....	12.0	.....	6.1	8.4	.....	7.7	.....	.....
1907.[b]												
1				13.0	7.3	8.9	10.1	5.7	5.2	5.0	3.8	2.6
2	5.8			13.2	7.4	8.9	9.9	5.5	5.1	5.0	3.9	2.0
3				13.1	7.4	8.8	9.8	5.4	4.8	5.0	3.9	1.9
4				13.3	7.3	8.6	9.4	5.3	4.7	5.0	4.0	1.6
5				13.0	7.1	8.4	9.0	5.1	4.6	5.1	4.0	1.7
6		6.2	6.1	12.8	6.9	8.3	8.6	4.9	4.6	4.9	4.1	1.4
7				12.7	6.7	8.1	8.4	4.9	4.2	4.8	4.2	1.3
8				12.6	6.7	7.9	8.1	4.8	3.9	4.8	4.1	1.4
9	5.8			12.2	6.7	7.7	7.9	4.9	3.8	4.7	4.1	2.0
10				11.9	6.5	7.6	8.1	4.9	3.8	4.7	4.0	2.0
11				11.7	6.4	8.2	6.8	4.7	3.8	4.6	4.0	.....
12				11.6	6.2	8.9	6.4	4.6	3.7	4.5	3.9	.....
13		5.8	5.8	11.3	6.2	9.5	6.1	4.3	3.6	4.5	3.9	.....
14				11.1	6.1	10.0	6.0	4.6	3.6	4.3	3.8	.....
15				10.8	6.0	10.4	6.3	4.4	3.6	4.2	3.3	.....
16	5.3		6.0	10.3	6.2	10.6	6.2	4.2	3.6	4.1	3.3	.....
17				10.0	6.3	10.9	6.2	4.5	3.7	4.1	3.4	2.6
18				9.7	6.3	11.0	6.2	4.4	4.2	4.0	3.5	.....
19				9.4	6.3	11.0	6.2	4.5	4.5	4.0	3.3	.....
20		6.0	6.5	9.2	6.2	10.9	6.2	4.7	5.0	4.0	3.3	.....
21				9.0	6.2	10.8	6.2	5.1	5.3	4.0	3.4	.....
22				8.7	6.3	10.8	6.3	5.5	5.7	4.0	3.4	.....
23	5.4		8.8	8.5	6.3	10.8	6.2	5.5	6.0	3.9	3.4	.....
24			8.6	8.3	6.2	10.8	6.2	5.4	6.2	3.9	3.4	3.0
25			8.8	8.0	6.2	10.9	6.7	5.2	6.3	4.0	3.2	.....
26			9.1	7.9	6.6	10.8	6.5	5.0	6.3	4.0	3.1	.....
27		6.3	10.1	7.8	7.0	10.8	6.4	4.9	6.0	4.0	3.0	.....
28			11.1	7.5	7.5	10.7	6.3	4.9	5.7	4.0	3.0	.....
29			11.3	7.5	8.0	10.7	6.2	5.0	5.5	3.9	3.1	.....
30	5.8		11.8	7.3	8.5	10.4	6.0	5.0	5.2	3.8	2.8	2.8
31			12.3	.....	8.7	.....	5.9	5.3	.....	3.8	.....	.....

[a] Ice from Jan. 1 to Mar. 31 and from Dec. 1 to 31.
[b] Ice from Jan. 1 to Mar. 23 and from Dec. 1 to 31.

Daily gage height, in feet, of Mississippi River at St. Paul, Minn., for 1892–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.[a]												
1	.....	.....	.....	5.9	7.4	13.6	16.4	7.3	3.8	3.9	3.9	3.0
2	.....	.....	.....	5.4	7.5	14.5	16.0	7.1	4.0	3.9	3.9	.....
3	.....	.....	.....	5.1	7.5	15.1	15.5	6.9	3.9	3.9	3.9	.....
4	.....	2.6	.....	5.3	7.4	15.3	15.0	6.5	3.9	3.9	3.9	1.6
5	.....	.....	.....	5.3	7.1	15.2	14.4	6.4	3.9	3.9	3.8	.....
6	.....	.....	.....	5.4	7.1	14.9	13.9	6.2	4.0	3.8	3.8	.....
7	.....	2.5	.....	5.4	6.7	14.5	13.4	6.0	3.9	3.9	3.8	.....
8	.....	.....	.....	5.5	6.4	14.4	12.9	5.9	3.6	3.9	3.8	3.2
9	2.6	.....	.....	5.6	6.1	14.0	12.7	5.7	3.6	3.9	3.9	.....
10	.....	.....	.....	5.5	5.9	14.2	12.3	5.4	3.5	3.9	3.3	.....
11	.....	.....	.....	5.5	5.8	14.4	11.8	5.0	3.3	3.7	3.2	2.8
12	.....	.....	.....	5.5	5.6	14.6	11.6	5.3	3.2	3.6	3.4	.....
13	.....	.....	.....	5.5	5.8	14.9	11.3	5.1	3.6	3.6	3.2	.....
14	.....	3.4	.....	5.4	5.7	15.0	11.0	4.9	3.2	3.7	3.0	.....
15	2.2	.....	.....	5.4	6.0	14.8	10.6	4.8	3.2	3.5	3.0	3.0
16	.....	.....	3.8	5.3	6.4	14.5	10.3	4.5	3.0	3.4	3.0	.....
17	2.4	.....	3.6	5.1	6.8	14.1	10.1	4.5	3.1	3.4	2.9	.....
18	.....	3.3	3.4	5.1	7.0	13.6	10.0	4.4	3.4	3.3	2.8	2.8
19	.....	.....	4.3	5.0	7.1	13.3	9.7	4.6	3.4	3.0	2.7	.....
20	.....	.....	4.1	5.0	7.3	12.9	9.5	4.5	3.3	3.4	2.7	.....
21	2.2	3.2	4.1	4.8	7.8	12.5	9.2	4.4	3.2	3.4	2.7	.....
22	.....	.....	4.4	5.2	8.1	12.2	9.1	4.3	3.1	3.4	2.6	2.8
23	.....	.....	4.4	5.0	8.2	12.2	9.0	4.1	3.5	3.4	2.6	.....
24	2.7	.....	4.6	5.0	8.5	12.2	8.8	4.0	3.5	3.4	2.6	.....
25	.....	3.2	4.8	5.1	9.1	12.3	8.6	4.0	3.6	3.5	2.7	.....
26	.....	.....	5.1	5.4	9.4	13.0	8.3	3.9	3.2	3.5	2.8	2.8
27	.....	.....	5.1	5.8	9.9	14.7	8.0	3.9	3.6	3.8	3.0	.....
28	2.3	3.1	5.4	6.2	10.5	16.3	7.6	4.0	3.4	3.9	3.0	.....
29	.....	.....	5.5	6.7	11.1	16.8	7.5	3.9	3.5	3.8	3.0	.....
30	.....	.....	5.7	7.1	11.8	16.7	7.6	3.9	3.8	4.0	3.0	2.9
31	2.4	.....	5.7	.....	12.5	.....	7.4	3.8	.....	4.0	.....	.....
1909.[b]												
1	.....	.....	.....	10.5	7.4	6.9	7.2	4.4	4.7	3.6	2.8	5.1
2	.....	3.5	2.8	11.4	7.4	7.4	7.4	4.3	4.5	3.6	3.0	5.4
3	.....	.....	.....	12.4	7.3	7.8	7.4	4.0	4.5	3.6	3.1	5.6
4	.....	.....	.....	13.0	7.3	8.1	7.3	3.9	4.3	3.4	2.9	5.8
5	3.1	3.6	2.7	13.0	7.4	8.2	7.4	3.8	4.2	3.3	3.1	5.8
6	.....	.....	.....	12.8	7.4	8.5	7.4	3.8	4.0	3.2	3.5	.....
7	.....	.....	.....	12.7	7.4	8.7	7.3	3.5	3.9	3.3	3.7	.....
8	3.2	.....	.....	12.5	7.6	8.8	7.2	3.5	3.9	3.3	3.7	.....
9	.....	3.6	3.5	12.2	7.6	8.5	7.1	3.5	3.8	3.2	3.6	.....
10	.....	.....	.....	11.9	7.6	8.4	6.8	3.5	3.7	3.2	3.5	4.1
11	.....	.....	.....	11.8	7.5	8.2	6.5	3.5	3.5	3.5	3.5	.....
12	3.1	.....	3.8	11.4	7.4	7.9	6.5	3.5	3.4	3.4	3.3	.....
13	.....	3.4	.....	11.0	7.2	7.6	6.3	4.0	3.8	3.6	3.4	.....
14	.....	.....	.....	10.5	7.0	7.8	5.9	4.5	4.0	3.5	3.4	5.1
15	3.0	.....	4.9	10.2	6.8	8.0	5.6	5.4	3.9	3.4	3.6	.....
16	.....	3.6	5.0	9.8	6.8	8.0	5.1	5.7	3.7	3.3	3.8	.....
17	.....	.....	5.3	9.5	6.7	8.1	5.1	6.1	3.6	3.3	3.9	5.0
18	.....	.....	5.1	9.3	6.7	8.2	5.0	6.3	3.5	3.2	3.9	.....
19	3.1	3.4	4.7	9.1	6.8	8.1	4.7	6.3	3.4	3.2	3.8	.....
20	.....	.....	4.4	8.8	6.8	8.0	4.5	6.3	3.2	3.2	3.8	.....
21	.....	.....	4.5	8.6	6.8	7.9	4.5	6.2	3.2	3.2	4.2	4.9
22	3.0	.....	4.3	8.3	6.8	7.8	4.5	6.0	3.7	3.1	4.4	.....
23	.....	3.4	4.5	8.2	6.8	7.6	4.7	5.7	4.0	3.2	4.5	.....
24	.....	.....	4.9	8.0	6.8	7.4	4.7	5.5	4.1	3.2	4.3	4.8
25	.....	.....	5.5	7.8	6.8	7.2	5.4	5.4	4.0	3.3	4.2	.....
26	3.0	3.0	5.8	7.7	6.8	7.2	5.5	5.4	4.0	3.2	4.4	.....
27	.....	.....	6.4	7.6	6.8	7.2	5.3	5.3	4.0	3.3	4.6	.....
28	.....	.....	7.8	7.5	6.8	7.2	5.2	5.2	4.0	3.2	4.9	.....
29	3.0	.....	8.3	7.4	6.8	7.2	5.1	5.1	3.9	3.3	4.9	.....
30	.....	.....	8.7	7.4	6.9	7.2	5.0	4.9	3.6	3.3	5.0	.....
31	.....	.....	9.6	.....	6.9	.....	4.7	4.7	.....	2.9	.....	.....

[a] Ice from Jan. 1 to Mar. 15 and from Nov. 25 to Dec. 31.
[b] Ice from Jan. 1 to Mar. 14 and from Nov. 21 to Dec. 31.

Daily gage height, in feet, of Mississippi River at St. Paul, Minn., for 1892–1910— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910.[a]												
1	.....	.....	.....	7.0	5.0	3.2	1.6	0.6	0.9	1.0	0.3	− 0.2
2	.....	3.2	.....	6.6	4.9	3.0	1.8	.6	.9	1.0	.3	.....
3	4.0	.....	.....	6.4	4.5	3.0	1.5	.8	1.0	1.0	.5	.....
4	.....	3.2	.....	6.0	4.3	3.2	1.3	.8	1.1	1.0	1.1	.....
5	.....	.....	.....	5.9	4.2	3.0	1.4	.6	1.0	1.3	1.0	.....
6	3.8	.....	.....	5.6	4.1	3.0	1.2	.6	.9	1.3	1.1	− .1
7	.....	.....	.....	5.6	4.1	3.0	0.9	.7	.9	1.7	1.0	.....
8	.....	3.2	4.5	5.6	4.1	3.0	.8	.7	1.0	1.8	1.0	.....
9	.....	.....	5.4	5.7	4.0	3.0	.8	.8	1.0	1.8	1.0	.3
10	.....	.....	6.0	5.5	4.0	3.0	1.2	.7	1.0	1.7	.9	.....
11	3.7	3.3	6.8	5.4	4.0	3.0	.9	.6	1.0	1.6	.8	.....
12	.....	.....	7.3	5.4	3.9	2.8	.9	.6	.9	1.6	.5	.....
13	.....	.....	7.0	5.2	3.8	2.3	1.0	.7	1.0	1.5	.4	.2
14	3.3	.....	7.5	5.1	3.8	2.7	.9	.7	.9	1.5	.3	.....
15	.....	.....	8.8	5.1	3.7	2.5	.9	.7	.9	1.5	.6	.8
16	.....	3.3	9.4	4.9	3.5	2.3	1.0	.8	1.0	1.5	.5	.....
17	.....	.....	9.9	4.8	3.4	2.0	.9	.8	1.0	1.3	.3	.....
18	3.3	3.2	10.3	4.8	3.6	2.3	.8	.8	1.0	.9	.2	.....
19	.....	.....	10.6	4.8	3.6	2.1	.8	.8	1.0	.8	− .3	.....
20	.....	.....	10.4	4.8	3.7	2.0	.7	.9	1.0	.8	− .2	.4
21	3.1	3.4	10.6	5.1	3.7	2.0	.6	1.0	1.0	.8	− .1	.....
22	.....	.....	10.4	5.2	3.8	1.9	.6	.9	1.0	.8	.1	.3
23	.....	.....	10.2	5.3	3.5	1.8	.6	1.0	.9	.8	.1	.....
24	.....	.....	9.9	5.3	3.8	1.6	1.1	.9	.9	.7	0	.....
25	3.2	3.4	9.3	5.4	3.8	1.8	.7	.9	.9	.7	0	.....
26	.....	.....	8.7	5.4	3.4	1.8	.6	.9	.9	.8	0	.....
27	.....	.....	8.5	5.5	3.8	1.8	.5	.9	.9	.6	0	.4
28	3.1	.....	8.1	5.4	3.4	1.8	.5	.9	.9	.6	.1	.....
29	.....	.....	7.8	5.3	3.6	1.7	.5	.8	.9	.5	.....	.....
30	.....	.....	7.5	5.1	3.4	1.4	.8	.8	1.0	.5	.....	.3
31	.....	.....	7.3	.....	3.2	.....	.8	.8	.....	.3	.....	.....

[a] Ice from Jan. 1 to Mar. 7 and from Nov. 29 to Dec. 31.

Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for 1892–1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov	Dec.
1892.												
1	.....	.....	4,000	10,600	8,520	39,500	23,900	15,200	7,520	6,440	5,060	.....
2	.....	.....	4,000	11,400	9,180	37,400	21,600	14,400	7,520	6,620	5,060	.....
3	.....	.....	4,000	12,700	9,400	35,800	20,700	16,000	8,300	6,640	4,920	.....
4	.....	.....	5,000	12,700	9,640	34,300	19,400	16,000	8,100	6,640	4,920	.....
5	.....	.....	5,000	10,600	9,640	32,700	18,000	13,000	7,900	6,280	4,920	.....
6	.....	.....	5,000	10,600	10,600	26,800	16,800	12,300	7,700	6,440	4,920	.....
7	.....	.....	8,100	10,900	11,200	30,200	16,000	11,700	7,700	6,280	4,920	.....
8	.....	.....	6,790	11,200	11,700	28,800	15,200	12,000	7,520	6,280	4,920	.....
9	.....	.....	6,440	10,900	10,600	30,700	14,000	11,400	7,520	6,280	4,920	.....
10	.....	.....	9,180	10,600	14,000	27,300	13,000	11,200	7,520	6,120	4,920	.....
11	.....	.....	10,600	10,100	15,600	29,700	12,000	10,600	7,700	6,120	4,780	.....
12	.....	.....	10,600	9,180	16,400	25,400	11,400	10,400	8,300	6,120	4,780	.....
13	.....	.....	10,600	8,950	16,400	25,400	10,900	9,880	8,300	6,120	4,920	.....
14	.....	.....	8,950	10,600	17,200	25,400	10,400	9,880	8,520	5,960	4,920	.....
15	.....	.....	8,730	10,400	18,000	24,900	9,640	9,400	8,300	5,960	4,780	.....
16	.....	.....	8,300	9,880	18,500	26,800	9,640	9,400	7,900	5,960	4,500	.....
17	.....	.....	7,900	9,400	18,500	29,200	9,400	9,180	7,520	5,800	4,110	.....
18	.....	.....	7,140	8,730	18,900	29,200	9,400	8,730	7,330	6,120	3,980	.....
19	.....	.....	7,140	8,520	19,800	30,200	10,600	8,520	6,960	5,960	4,110	.....
20	.....	.....	6,960	9,180	28,300	30,200	10,600	8,300	6,790	5,800	4,110	.....
21	.....	.....	6,440	8,100	33,800	30,700	10,900	8,100	6,790	5,800	3,980	.....
22	.....	.....	6,620	7,330	36,800	30,200	10,600	7,900	6,790	5,640	3,980	.....
23	.....	.....	6,280	7,330	40,100	29,200	10,900	7,700	6,620	5,640	3,980	.....
24	.....	.....	5,960	6,960	42,800	27,300	10,600	7,520	6,620	5,500	3,610	.....
25	.....	.....	6,120	6,620	45,100	26,300	10,400	7,520	6,440	5,500	3,600	.....

Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for 1892-1910 — Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1892.												
26			4,920	7,140	45,700	25,400	10,400	7,330	6,440	5,500	3,500	.....
27			5,200	6,960	45,100	25,400	15,600	7,140	6,440	5,340	3,500	.....
28			5,500	6,960	44,500	25,800	16,400	7,140	6,280	5,340	3,400	.....
29			5,640	7,700	43,400	25,400	15,200	6,960	6,440	5,200	3,400	.....
30			8,300	8,300	41,700	24,900	15,600	7,520	6,620	5,200	3,400	.....
31			9,880	.....	41,200	.....	15,600	7,700	.....	5,200	.....	.....
1893.												
1			.....	18,900	47,500	29,200	8,410	4,900	5,740	5,740	6,100	3,980
1			.....	22,500	52,400	27,800	8,000	4,900	6,100	5,920	5,400	3,840
3			.....	24,900	55,600	26,300	7,800	4,900	6,100	5,740	5,920	4,130
4			.....	28,800	57,500	24,900	7,800	4,740	5,740	5,560	5,560	4,130
5			.....	32,700	58,800	23,900	8,000	4,740	5,740	5,740	5,400	3,980
6			.....	34,300	58,800	22,500	7,800	4,740	5,920	6,100	5,400	4,280
7			.....	34,800	58,800	22,100	7,410	4,740	5,740	6,280	5,740	4,280
8			.....	34,800	58,200	21,100	7,800	4,740	5,560	6,280	5,740	4,280
9			.....	35,800	56,800	19,800	7,800	4,430	5,560	6,100	5,560	4,280
10			.....	36,300	54,900	18,500	7,600	4,280	5,920	6,100	5,220	.....
11			.....	35,300	52,400	17,600	7,800	4,130	5,740	5,920	5,060	.....
12			.....	35,300	49,900	16,800	8,000	4,280	5,920	5,920	5,060	.....
13			.....	34,800	47,500	15,900	8,000	4,430	5,920	5,920	4,900	.....
14			.....	33,200	46,300	14,700	8,000	4,580	6,100	5,920	4,900	.....
15			.....	32,700	43,400	14,000	8,000	4,900	6,100	5,920	4,900	.....
16			.....	31,200	41,700	13,200	7,800	4,900	6,100	5,920	4,900	.....
17			.....	31,200	40,600	12,800	7,600	4,900	6,100	6,100	4,580	.....
18			.....	30,700	39,500	12,200	7,410	4,900	6,100	6,100	4,430	.....
19			.....	29,700	37,900	11,500	7,220	4,740	6,280	6,100	4,130	.....
20			.....	29,700	36,800	11,200	7,020	4,740	6,280	6,100	3,400	.....
21			.....	29,700	35,300	10,900	6,640	4,740	6,100	6,100	3,260	.....
22			.....	28,800	33,200	10,600	6,460	4,740	5,920	6,100	3,400	.....
23			.....	27,300	31,700	10,100	6,280	4,740	5,920	6,100	3,260	.....
24			.....	27,300	30,200	9,800	5,920	4,580	5,920	6,100	3,120	.....
25			.....	27,800	30,200	9,550	5,740	4,740	5,920	6,100	2,980	.....
26			.....	30,200	31,700	9,550	5,560	4,430	5,920	5,920	2,440	.....
27			.....	34,300	32,200	9,550	5,560	4,280	5,920	5,920	3,260	.....
28			.....	37,400	32,700	9,550	5,400	4,430	5,920	5,920	4,130	.....
29			.....	41,200	32,700	9,070	5,400	5,060	5,740	5,920	4,280	.....
30			.....	44,500	31,700	8,840	4,900	5,220	5,920	5,920	4,280	.....
31			.....	.....	30,700	.....	5,060	5,400	.....	6,100	.....	.....
1894.												
1			4,000	7,220	26,800	18,000	5,740	2,310	3,840	3,980	4,580	3,450
2			4,000	6,840	27,300	17,200	5,740	2,180	3,540	4,430	4,580	3,400
3			4,000	6,840	28,300	15,900	5,560	2,180	3,840	4,430	4,740	3,350
4			5,000	5,920	28,800	15,100	5,400	2,440	3,840	4,430	4,740	3,300
5			5,000	6,100	28,300	14,700	5,220	2,180	3,840	4,430	4,740	3,200
6			5,000	6,100	28,800	14,000	5,060	1,920	3,690	4,280	4,580	3,150
7			6,000	5,920	28,300	12,800	4,900	2,180	3,840	4,580	4,740	3,100
8			8,620	5,920	28,300	12,200	4,580	2,310	3,980	4,580	4,740	3,050
9			9,070	5,920	27,800	11,200	4,430	2,050	4,130	4,430	4,580	3,000
10			8,200	6,460	27,800	10,600	4,430	2,310	4,130	4,430	4,430	2,950
11			7,800	6,640	27,300	10,100	4,430	3,260	3,980	4,580	4,280	2,820
12			7,020	7,020	25,800	9,550	4,430	3,540	4,130	4,740	4,130	2,820
13			6,640	7,220	23,900	9,310	4,280	3,980	4,130	4,580	4,280	2,820
14			6,840	7,410	23,900	8,840	4,130	4,280	4,130	4,430	4,280	2,820
15			6,840	7,600	23,500	8,410	4,130	3,980	4,130	4,280	4,280	2,820
16			6,840	8,200	24,900	8,200	3,980	4,130	4,280	4,130	4,280	2,820
17			6,840	9,310	28,800	8,000	3,690	3,980	4,280	4,130	2,980	2,820
18			6,840	11,500	32,200	7,800	3,690	3,690	4,280	3,840	2,980	2,820
19			7,020	15,500	38,400	7,600	3,690	3,980	3,980	3,840	3,120	2,820
20			7,600	19,800	40,600	7,410	3,980	4,130	3,840	3,980	4,130	2,820
21			8,000	24,400	41,200	7,020	3,840	4,130	3,690	4,430	4,430	2,820
22			8,200	28,300	40,600	7,020	3,400	4,280	3,690	4,130	4,130	2,750
23			8,200	31,700	38,400	6,640	3,260	4,280	3,840	4,130	3,260	2,690
24			8,200	33,800	35,300	6,100	3,400	4,430	3,840	3,980	3,260	2,590
25			6,640	34,800	32,200	6,100	3,400	4,280	3,980	4,130	3,690	2,500
26			5,560	33,800	29,200	6,100	2,980	4,130	3,980	3,980	3,690	2,400
27			4,900	32,200	25,800	5,920	2,980	4,130	3,690	3,840	3,540	2,300
28			4,430	30,200	23,900	5,920	2,840	4,280	3,690	3,840	3,500	2,200
29			6,100	28,300	21,600	5,740	2,710	3,690	3,690	4,130	3,500	2,100
30			7,020	27,300	20,200	5,920	1,920	3,840	3,840	4,280	3,500	2,000
31			8,000	.....	19,400	.....	2,440	3,980	.....	4,580	.....	1,900

Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for 1892–1910— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1895.												
1	1,900	.....	.....	3,610	3,230	4,640	7,700	4,110	4,640	5,500	4,110	.....
2	1,830	.....	.....	3,610	3,370	4,920	7,900	3,980	4,240	5,060	3,860	.....
3	1,760	.....	.....	3,610	3,490	6,120	7,700	3,610	4,500	5,200	3,860	.....
4	1,710	1,060	.....	3,490	3,730	5,960	7,140	3,610	4,500	5,200	3,860	.....
5	1,680	1,320	.....	3,610	3,980	5,800	6,620	3,490	4,640	5,060	4,110	.....
6	1,650	1,300	.....	3,610	4,110	6,280	6,620	3,730	4,640	5,200	4,240	.....
7	1,620	.....	.....	3,610	4,780	6,120	6,440	3,370	4,780	5,060	3,860	.....
8	1,590	.....	.....	3,490	4,920	6,280	6,440	3,490	4,920	5,200	4,110	.....
9	1,560	.....	.....	3,610	5,060	6,440	6,620	3,610	4,780	5,200	4,240	.....
10	1,310	.....	.....	3,360	5,060	6,620	6,620	3,980	4,920	5,060	4,110	.....
11	1,420	1,220	.....	3,610	5,640	8,100	6,120	4,370	4,920	5,060	3,980	.....
12	1,530	1,370	.....	3,860	5,340	8,520	5,960	4,500	4,920	5,060	4,240	.....
13	1,590	1,460	.....	3,610	5,340	8,520	5,800	4,640	4,920	4,780	4,110	.....
14	1,650	1,360	.....	3,610	5,200	9,180	5,500	4,780	4,780	4,500	4,110	.....
15	1,710	.....	.....	3,490	4,920	9,400	5,640	5,340	4,500	4,780	4,240	.....
16	1,660	.....	.....	3,490	5,200	9,640	5,500	4,920	4,240	4,640	4,240	.....
17	1,610	.....	.....	3,370	4,920	9,640	5,340	4,920	4,780	4,780	4,110	.....
18	1,560	.....	.....	3,370	4,920	9,400	5,800	5,200	4,500	4,640	3,980	.....
19	1,500	.....	.....	3,230	4,640	8,950	5,640	4,920	4,640	4,500	4,110	.....
20	1,540	.....	.....	3,230	4,240	8,300	5,340	5,200	4,640	4,500	4,240	.....
21	1,590	.....	.....	3,230	4,640	7,900	5,060	4,920	4,780	4,240	3,490	.....
22	1,550	.....	2,630	3,370	4,500	7,700	4,780	4,640	5,060	4,500	3,110	.....
23	1,340	.....	2,750	3,490	4,240	7,520	4,780	4,500	5,340	4,240	3,110	.....
24	1,400	.....	2,990	3,110	4,240	7,330	4,640	4,640	5,640	4,370	2,990	.....
25	1,380	.....	3,110	2,990	4,240	7,140	4,640	4,640	5,500	4,240	3,110	.....
26	1,400	.....	3,110	3,110	4,370	7,140	4,640	4,500	5,340	4,240	3,110	.....
27	1,420	.....	3,610	3,490	4,240	7,140	4,640	4,780	5,200	4,110	3,110	.....
28	1,440	.....	4,110	3,110	4,500	7,330	4,500	4,640	5,200	3,860	3,000	.....
29	1,520	.....	3,980	2,750	4,640	7,520	4,240	4,640	5,200	4,240	3,000	.....
30	1,250	.....	3,980	3,490	4,640	7,700	4,640	4,500	5,060	4,110	3,000	.....
31	1,200	.....	3,980	.....	4,500	.....	4,240	4,500	.....	4,110	.....	.....
1896.												
1	.....	.....	.....	3,230	21,600	27,300	12,700	4,780	5,060	5,060	5,640	4,500
2	.....	.....	.....	2,400	23,500	25,400	11,700	4,640	4,640	5,060	5,640	5,000
3	.....	.....	.....	2,280	24,900	24,400	11,400	4,640	4,500	4,920	6,280	4,580
4	.....	.....	.....	2,870	26,300	22,500	11,200	5,060	4,110	5,060	6,120	4,490
5	.....	.....	.....	3,600	27,300	22,100	10,900	4,500	4,110	4,780	6,120	4,550
6	.....	.....	.....	4,110	27,800	20,200	10,100	4,500	3,980	5,200	6,120	4,510
7	.....	.....	.....	4,500	28,300	22,100	9,880	4,640	4,110	4,780	6,280	4,470
8	.....	.....	.....	4,640	27,300	22,500	9,640	5,060	4,370	4,640	6,440	4,430
9	.....	.....	.....	4,640	26,800	23,500	8,950	4,920	4,500	4,640	6,280	4,390
10	.....	.....	2,170	4,640	25,800	24,900	8,730	4,920	4,780	4,780	6,280	4,300
11	.....	.....	.....	1,950	5,060	25,400	25,800	8,520	5,200	4,920	4,780	5,800	4,290
12	.....	.....	.....	2,060	5,960	23,900	26,300	8,520	5,340	4,780	5,060	5,200	4,290
13	.....	.....	.....	2,170	8,100	23,900	26,300	8,300	5,640	4,640	5,200	4,780	4,280
14	.....	.....	.....	2,400	17,600	23,900	25,400	8,100	5,800	4,640	5,200	4,920	4,280
15	.....	.....	.....	2,400	23,500	24,400	23,900	7,900	5,800	4,780	5,340	5,060	4,270
16	.....	.....	.....	1,840	29,200	24,900	22,100	7,330	5,640	5,200	5,200	4,640	4,270
17	.....	.....	.....	2,170	34,300	27,800	20,200	6,790	5,500	5,340	5,200	4,920	4,260
18	.....	.....	.....	1,950	35,300	29,700	18,500	6,440	5,340	5,340	5,060	4,920	4,260
19	.....	.....	.....	1,420	33,800	31,700	17,200	6,280	5,200	5,340	5,060	4,920	4,250
20	.....	.....	.....	1,420	31,200	33,200	16,400	6,120	5,060	5,200	5,200	4,370	4,250
21	.....	.....	.....	1,520	29,200	34,300	15,600	6,280	5,060	5,060	5,200	4,240	4,240
22	.....	.....	.....	1,420	26,800	34,300	14,000	5,960	4,920	4,920	5,060	4,640	4,530
23	.....	.....	.....	1,520	24,900	33,800	14,400	5,960	5,060	4,920	4,920	4,200	4,150
24	.....	.....	.....	1,950	23,500	32,700	15,200	5,800	5,060	4,920	4,920	4,200	4,260
25	.....	.....	.....	1,950	21,100	31,700	16,000	5,800	5,200	4,780	5,060	4,200	4,360
26	.....	.....	.....	2,170	20,200	30,200	16,400	5,640	4,920	4,920	4,920	4,200	4,460
27	.....	.....	.....	2,170	19,400	29,200	16,800	5,500	4,920	5,060	4,780	4,000	4,570
28	.....	.....	.....	2,280	18,000	29,200	16,000	5,060	4,920	5,060	4,920	4,000	4,670
29	.....	.....	.....	2,520	18,500	29,200	14,400	4,920	4,780	5,060	4,780	4,000	4,550
30	.....	.....	.....	2,630	19,800	29,200	13,700	4,780	4,640	4,920	5,340	4,000	4,430
31	.....	.....	.....	3,230	.....	28,300	.....	4,640	4,780	.....	5,640	.....	4,500
1897.												
1	5,300	3,400	3,250	60,800	29,800	10,200	14,400	24,600	8,500	10,100	7,600	.....
2	5,340	3,450	3,300	68,700	28,800	11,000	14,800	23,700	8,500	9,800	7,800	.....
3	5,200	3,320	3,360	74,000	27,900	11,000	15,200	23,300	8,720	9,550	7,800	.....
4	5,100	3,330	3,340	76,300	25,600	11,000	15,600	22,400	8,720	9,070	7,800	.....
5	4,950	3,400	3,310	80,100	24,200	11,600	20,200	21,500	8,720	9,310	7,600	.....

Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for 1892–1910— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1897.												
6	4,810	3,400	3,170	80,800	22,800	11,900	24,600	20,600	8,940	9,070	7,600	.....
7	5,010	3,420	3,220	79,300	21,500	12,300	29,300	19,300	8,940	9,070	7,600	.....
8	5,210	3,440	3,270	78,600	20,200	12,600	40,100	19,700	8,720	8,840	7,600	.....
9	5,100	3,460	3,320	79,300	18,900	12,300	45,900	18,900	8,720	8,840	7,600	.....
10	5,170	3,480	3,150	78,600	17,600	12,300	47,700	17,200	8,500	8,620	7,410	.....
11	5,240	3,500	3,230	77,000	16,800	12,600	49,600	16,000	8,500	8,200	7,220	.....
12	4,500	3,550	3,320	74,000	16,400	12,300	48,900	14,800	8,500	8,410	7,220	.....
13	4,520	3,490	3,000	70,200	15,600	11,600	47,700	13,700	8,720	8,410	7,220	.....
14	4,560	3,450	3,060	67,300	15,200	11,900	45,900	12,600	9,400	8,200	7,220	.....
15	4,600	3,410	3,120	63,600	14,800	11,900	43,500	11,900	9,900	8,000	7,220	.....
16	4,390	3,380	3,180	60,100	14,400	12,300	47,700	11,300	10,900	8,000	7,220	.....
17	4,340	3,270	3,160	58,000	14,100	12,300	39,000	11,000	11,800	8,000	7,020	.....
18	4,290	3,170	3,320	56,000	14,100	12,600	36,300	10,700	11,800	7,800	7,020	.....
19	4,240	3,130	4,250	52,100	14,100	13,300	33,700	10,700	11,800	8,000	6,840	.....
20	4,080	3,180	5,440	50,200	14,100	14,100	31,800	10,400	11,500	8,200	6,640	.....
21	3,880	3,230	9,400	47,700	14,100	14,800	30,800	10,200	11,200	8,200	6,460	.....
22	3,680	3,280	11,000	45,900	13,300	15,200	29,300	10,200	11,500	8,200	6,460	.....
23	3,480	3,350	14,400	44,700	12,600	15,600	28,400	9,900	11,500	8,200	5,920	.....
24	3,440	3,390	18,900	42,400	11,900	15,200	27,900	9,650	11,200	8,410	5,400	.....
25	3,400	3,270	22,400	40,600	11,600	14,800	27,400	9,650	10,900	8,200	5,220	.....
26	3,350	3,190	25,600	38,400	11,300	13,700	28,800	9,650	10,300	8,200	5,060	.....
27	3,300	3,120	27,400	36,800	11,300	13,000	28,800	9,160	10,300	8,000	4,900	.....
28	3,340	3,200	29,300	34,700	11,000	13,000	27,900	8,940	10,300	7,800	4,900	.....
29	3,050	.....	30,300	32,700	10,700	13,300	27,000	8,720	10,300	7,800	4,800	.....
30	3,200	.....	41,200	31,300	10,400	14,100	25,600	8,500	10,100	7,600	4,700	.....
31	3,300	.....	48,900	.....	10,400	.....	25,100	8,500	.....	7,600	.....	.....
1898.												
1	.....	.....	4,000	7,900	6,790	11,200	10,100	7,900	6,790	6,620	8,100	.....
2	.....	.....	4,000	7,520	6,960	11,200	10,600	7,900	6,620	6,280	8,100	.....
3	.....	.....	4,000	7,520	7,140	11,200	10,400	7,520	6,280	6,120	7,900	.....
4	.....	.....	5,000	7,520	7,140	10,600	10,400	7,330	6,120	6,120	7,900	.....
5	.....	.....	5,000	7,900	7,520	10,900	10,600	6,960	6,120	6,120	7,900	.....
6	.....	.....	5,000	8,100	7,520	26,300	11,200	7,900	6,120	6,280	7,700	.....
7	.....	.....	5,000	8,100	7,700	33,200	12,000	7,140	6,120	6,620	7,330	.....
8	.....	.....	7,700	8,100	7,520	35,300	12,300	7,140	5,960	6,790	7,330	.....
9	.....	.....	7,900	8,100	7,140	35,300	12,700	6,960	5,960	6,790	7,330	.....
10	.....	.....	8,520	7,900	7,140	34,300	14,000	6,790	5,960	6,960	7,140	.....
11	.....	.....	8,730	7,900	6,620	32,700	15,200	6,440	6,280	7,520	7,140	.....
12	.....	.....	8,520	8,300	6,620	31,200	16,400	6,440	6,120	7,330	6,960	.....
13	.....	.....	7,520	8,300	6,280	29,700	17,200	6,440	6,120	7,900	6,960	.....
14	.....	.....	6,620	8,100	6,280	28,800	16,000	6,120	6,440	8,300	6,620	.....
15	.....	.....	8,730	8,520	6,620	26,800	14,400	5,960	6,620	8,300	6,620	.....
16	.....	.....	8,100	8,520	6,440	23,900	13,300	6,440	6,620	8,520	6,620	.....
17	.....	.....	7,900	8,300	6,440	21,600	12,000	6,120	6,440	8,520	6,620	.....
18	.....	.....	7,700	8,100	6,440	19,800	11,400	6,120	6,440	8,730	6,620	.....
19	.....	.....	8,300	8,100	6,620	18,500	10,900	6,120	6,120	8,730	6,620	.....
20	.....	.....	8,100	8,100	6,790	17,200	10,600	5,960	6,120	8,950	6,790	.....
21	.....	.....	7,900	7,900	6,960	16,000	10,100	6,120	6,120	9,180	6,620	.....
22	.....	.....	7,900	7,700	7,900	15,200	9,640	6,120	6,120	9,400	6,620	.....
23	.....	.....	7,700	7,330	8,300	14,800	9,180	6,120	6,280	9,640	6,000	.....
24	.....	.....	6,440	7,140	8,950	13,700	8,950	6,280	6,280	9,640	6,000	.....
25	.....	.....	7,140	6,620	9,640	12,700	8,730	6,440	6,620	9,640	6,000	.....
26	.....	.....	7,900	6,790	9,880	11,400	8,730	6,440	6,620	9,400	5,000	.....
27	.....	.....	8,100	6,440	9,400	10,900	8,730	6,440	6,620	9,400	5,000	.....
28	.....	.....	7,520	6,440	9,880	10,600	8,300	6,620	6,620	9,180	5,000	.....
29	.....	.....	6,120	6,440	10,100	10,100	8,100	6,790	6,620	8,730	5,000	.....
30	.....	.....	6,120	6,440	10,600	9,880	8,100	6,960	6,790	8,520	5,000	.....
31	.....	.....	7,140	.....	10,600	.....	8,300	6,960	.....	8,300	.....	.....
1899.												
1	.....	.....	.....	8,000	15,200	12,700	25,400	8,300	19,800	9,180	18,500	9,880
2	.....	.....	.....	8,000	16,000	16,000	25,400	7,900	18,500	8,950	18,000	9,880
3	.....	.....	.....	8,000	16,800	20,700	24,400	7,700	17,200	8,730	17,600	9,640
4	.....	.....	.....	9,000	17,600	23,000	23,500	7,700	16,400	8,730	16,800	9,400
5	.....	.....	.....	9,000	18,000	24,400	22,100	7,520	15,200	8,730	16,400	8,730
6	.....	.....	.....	9,000	18,500	25,400	21,100	7,330	14,400	8,520	16,000	8,730
7	.....	.....	.....	9,000	19,800	27,800	19,800	7,330	14,400	8,520	15,600	5,640
8	.....	.....	.....	10,600	20,200	29,700	18,900	7,330	14,000	8,520	15,200	5,640
9	.....	.....	.....	17,200	19,800	30,200	17,600	7,330	13,300	8,300	14,400	6,790
10	.....	.....	.....	19,400	18,500	30,700	16,800	7,700	13,000	8,300	14,000	6,790

Daily discharge, in second feet, of Mississippi River at St. Paul, Minn., for 1892–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1899.												
11				19,800	17,200	31,200	15,600	8,100	12,700	8,300	13,700	6,790
12				22,500	16,400	30,200	14,400	8,300	12,700	8,520	13,700	6,790
13				30,700	15,600	31,200	13,700	8,520	12,700	8,520	13,300	.....
14				34,300	14,400	31,700	13,300	7,900	12,300	8,950	13,000	.....
15				33,200	14,000	33,200	13,300	7,900	12,300	9,180	12,700	.....
16				33,800	13,700	34,300	13,700	7,900	12,300	9,640	12,300	.....
17				33,800	14,000	34,800	12,700	8,300	12,000	11,400	12,000	.....
18				33,800	14,000	35,800	11,700	8,300	11,400	13,000	11,700	.....
19				32,200	13,700	36,300	11,200	8,300	11,200	16,400	11,700	.....
20				29,200	13,300	36,300	10,900	8,950	10,900	19,800	11,400	.....
21				25,800	13,300	36,300	10,600	9,640	10,600	22,100	11,200	.....
22				22,100	13,300	36,800	10,600	13,000	10,600	23,900	10,900	.....
23				19,400	13,300	36,800	10,600	16,000	10,600	25,400	10,600	.....
24				17,600	13,000	36,300	10,100	22,100	10,600	25,800	10,600	.....
25				16,400	13,000	35,300	9,880	25,400	10,400	25,400	10,600	.....
26				15,600	13 000	33,200	9,640	25,800	10,400	24,900	10,600	.....
27				14,800	12,700	31,200	9,400	25,400	10,100	23,000	10,400	.....
28				14,000	13,000	29,200	8,950	24,400	10,100	22,100	10,400	.....
29				14,000	13,000	27,800	8,730	23,500	9,880	21,100	10,100	.....
30				14,400	12,700	25,800	8,520	22,100	9,400	20,200	10,100	.....
31				.....	12,700	.....	8,300	20,700	.....	19,400	.....	.....
1900.												
1				7,140	7,700	6,790	3,370	3,730	11,700	13,000	9,400	.....
2				6,440	7,700	6,440	3,260	3,860	11,400	13,000	9,400	.....
3				6,790	7,900	6,280	3,610	3,860	10,600	13,300	9,400	.....
4				7,700	7,900	5,960	4,920	3,860	10,100	13,300	9,400	.....
5				7,900	7,900	5,800	5,800	3,610	9,880	14,800	9,640	.....
6				9,640	7,700	5,640	6,280	3,610	9,400	15,600	9,640	.....
7				12,300	7,330	5,640	6,280	3,610	8,730	16,000	9,640	.....
8				12,300	7,140	5,500	6,440	3,730	8,300	14,800	9,400	.....
9				11,200	6,960	5,500	6,280	3,860	8,100	14,400	9,180	.....
10				10,600	7,330	5,500	6,280	4,240	8,700	13,700	8,950	.....
11				10,100	6,790	4,640	6,120	5,200	9,180	13,300	8,730	.....
12				9,400	6,440	4,640	6,120	6,120	11,400	13,000	8,520	.....
13				8,950	6,280	4,780	6,440	6,280	13,000	12,700	8,300	.....
14				8,730	6,120	4,780	6,440	7,330	12,700	12,700	7,900	.....
15				8,520	6,120	4,240	6,120	7,700	12,000	11,700	7,330	.....
16				8,300	6,120	4,240	6,120	8,300	11,400	11,400	5,960	.....
17				9,180	6,120	4,110	5,800	8,730	11,200	11,400	5,060	.....
18				9,640	6,280	3,980	5,640	8,950	10,900	11,400	4,920	.....
19				10,100	6,280	3,980	5,340	8,730	10,600	11,200	4,920	.....
20				9,640	5,800	3,860	5,200	8,300	11,200	10,900	5,060	.....
21				9,180	5,640	3,860	5,200	7,900	12,000	10,600	5,060	.....
22				8,730	5,960	3,860	5,200	7,700	12,700	10,100	5,060	.....
23				8,300	6,120	3,860	5,200	7,700	13,300	10,100	4,920	.....
24				8,300	6,120	3,860	5,060	8,100	13,300	9,640	4,780	.....
25				8,300	6,120	3,610	4,640	8,520	13,700	9,400	4,370	.....
26				8,100	5,960	3,610	4,240	9,400	13,700	9,400	3,980	.....
27				7,900	6,120	3,610	3,730	9,880	13,700	8,950	4,640	.....
28				7,900	6,120	3,490	3,730	10,600	13,700	9,400	5,060	.....
29				7,900	6,790	3,490	3,980	11,700	13,300	9,640	4,920	.....
30				7,700	6,960	3,370	3,610	12,000	13,000	9,400	4,920	.....
31				.....	6,960	.....	3,610	11,700	.....	8,950	.....	.....
1901.												
1				11,700	13,700	10,600	13,700	7,900	5,800	5,800	5,960	.....
2				12,300	13,700	10,400	14,800	7,700	6,120	5,800	5,960	.....
3				12,300	14,000	10,100	15,200	7,140	5,960	5,800	6,120	.....
4				13,000	14,000	10,100	15,600	6,960	5,960	5,960	5,960	.....
5				14,000	16,800	9,880	15,600	6,620	5,800	5,960	5,960	.....
6				15,600	17,200	9,880	16,000	6,440	5,800	5,800	5,960	.....
7				15,200	18,600	9,400	16,400	6,440	5,800	5,500	5,800	.....
8				15,600	18,500	8,950	17,200	6,280	5,640	5,500	5,800	.....
9				16,800	18,900	8,730	17,600	6,120	5,500	5,500	5,640	.....
10				18,500	18,900	8,520	18,000	5,960	5,640	5,500	5,640	.....
11				18,900	18,900	8,730	18,500	5,800	5,800	5,640	5,640	.....
12				19,800	18,000	8,950	18,500	5,500	5,960	5,800	5,800	.....
13				18,500	17,600	8,950	18,500	5,340	5,640	5,800	5,640	.....
14				16,400	17,600	8,520	17,600	5,640	5,640	5,960	5,640	.....
15				15,600	17,200	8,950	17,200	5,960	5,500	6,280	5,640	.....

Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for 1892-1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1901.												
16				15,600	16,800	8,950	16,800	6,280	5,340	6,620	5,500	
17				16,400	16,400	8,520	16,400	6,280	5,340	6,440	4,780	
18				16,000	16,400	8,300	16,000	6,120	5,200	6,440	4,240	
19				16,000	16,000	8,300	15,200	5,960	5,060	6,280	4,370	
20				16,000	15,600	8,730	14,000	5,800	5,060	6,280	4,370	
21				15,600	15,200	9,180	13,000	5,800	5,060	6,280	4,370	
22				15,600	14,400	10,600	12,000	5,800	4,920	6,120	4,370	
23				15,600	14,400	12,000	11,400	5,640	4,920	6,120	4,500	
24				15,200	14,000	12,300	10,600	5,640	4,920	5,960	4,500	
25			11,700	15,200	13,300	12,700	10,100	5,640	5,060	5,960	3,980	
26			13,000	14,800	13,000	12,700	9,400	5,500	5,200	5,800	4,370	
27			12,700	14,800	12,300	12,700	8,950	5,640	5,340	5,800	4,240	
28			11,700	14,800	11,700	12,300	8,520	5,800	5,500	5,800	4,110	
29			11,200	14,400	11,400	14,000	8,300	5,800	5,640	5,800	3,980	
30			11,400	14,000	11,200	14,400	8,100	5,800	5,500	5,960	4,240	
31			11,400		10,900		8,100	5,800		5,960		
1902.												
1			3,000	5,060	4,780	14,800	9,880	7,140	4,240	4,780	5,500	7,140
2			3,100	5,060	4,920	14,000	9,640	6,620	4,370	4,920	5,500	6,620
3			3,200	5,200	4,780	13,700	9,180	6,280	4,920	4,920	5,640	6,440
4			3,300	5,200	5,060	14,000	8,950	5,800	5,500	5,060	5,800	
5			3,400	5,060	5,060	15,200	8,730	5,800	5,960	5,060	5,960	
6			3,400	4,920	5,200	16,000	8,730	5,340	6,280	5,060	6,440	
7			3,500	4,640	5,200	16,400	8,300	5,340	6,620	5,200	6,790	
8			3,500	4,640	5,340	16,400	8,100	5,500	6,280	5,200	7,140	
9			3,600	4,780	5,500	16,800	8,100	5,500	6,440	5,200	7,330	
10			3,730	4,920	6,120	16,800	8,520	6,120	6,440	5,200	7,330	
11			3,860	4,780	8,520	16,400	8,950	5,500	6,280	5,200	7,330	
12			3,860	4,640	8,950	16,400	8,950	5,200	5,960	5,200	7,330	
13			3,860	4,500	9,400	16,400	8,950	5,200	5,640	4,920	7,520	
14			4,240	4,500	9,180	16,000	8,520	5,060	5,200	4,920	7,520	
15			4,640	4,370	8,950	15,200	8,100	5,060	4,920	4,920	7,520	
16			5,060	4,370	8,730	14,400	7,900	4,920	5,060	4,780	7,520	
17			4,400	4,500	8,730	14,000	8,300	4,920	5,200	4,780	7,700	
18			4,400	4,240	8,950	13,700	7,900	4,640	5,200	4,640	8,100	
19			4,240	4,110	8,950	13,000	7,330	4,500	5,060	4,640	8,520	
20			4,780	3,980	9,180	12,300	7,140	4,500	4,920	4,500	8,950	
21			5,060	3,860	9,180	12,000	6,440	4,370	5,200	4,500	9,400	
22			5,200	3,980	9,400	11,700	6,120	4,640	5,060	4,640	9,400	
23			5,200	3,980	12,300	11,200	5,800	4,640	5,200	4,640	9,640	
24			5,340	3,860	17,200	10,900	5,640	4,640	5,200	4,640	9,400	
25			5,800	3,860	19,400	10,900	5,640	4,240	5,060	4,640	9,400	
26			5,960	4,500	19,800	10,400	5,960	4,370	4,920	4,640	9,180	
27			6,120	4,640	19,800	10,100	6,120	4,370	4,920	4,640	9,180	
28			5,800	4,500	18,900	10,100	6,120	4,240	4,780	4,780	8,730	
29			5,400	4,500	17,600	10,100	6,280	4,110	4,640	5,060	7,900	
30			5,340	4,640	16,400	9,880	6,960	4,110	4,640	5,340	7,520	
31			5,060		15,600		7,140	4,110		5,340		
1903.												
1			2,000	20,600	18,200	34,700	7,170	12,300	8,390	26,300	19,000	
2			2,000	19,000	18,200	39,100	7,170	13,000	8,390	24,000	17,800	
3			2,200	18,600	17,800	42,500	7,760	13,700	8,610	22,700	16,600	
4			2,200	18,600	17,800	42,500	10,000	14,700	8,830	22,700	15,500	
5			2,400	18,600	17,800	40,200	14,400	15,100	9,300	22,700	15,100	
6			2,600	18,200	18,200	36,400	16,200	15,500	9,300	24,000	15,100	
7			3,000	19,400	18,600	33,200	17,400	15,500	9,300	29,600	15,100	
8			4,000	19,400	19,000	29,600	17,400	15,800	9,540	36,400	14,700	
9			5,000	19,000	19,400	26,800	17,400	15,500	9,790	40,800	14,700	
10			6,000	18,200	19,000	24,000	18,600	14,700	9,790	44,200	14,000	
11			7,000	19,000	19,000	21,000	19,800	14,000	9,540	47,100	13,000	
12			8,000	20,200	21,000	17,800	21,000	13,300	10,300	48,800	12,600	
13			9,000	21,800	24,000	14,700	21,400	12,300	19,800	50,600	12,600	
14			10,000	23,200	27,200	13,000	20,600	11,700	25,400	51,800	12,600	
15			14,700	24,500	30,100	12,600	19,400	11,400	29,200	51,200	12,600	
16			15,100	25,400	32,600	12,300	18,600	11,100	32,200	49,400	12,300	
17			15,800	26,300	34,200	11,700	18,600	10,800	34,700	47,600	12,000	
18			15,500	26,800	36,400	10,800	18,600	10,800	36,400	45,900	11,400	
19			15,800	26,300	36,900	10,300	16,600	10,800	38,000	43,600	10,300	
20			19,000	25,800	36,400	10,000	15,500	10,800	40,200	40,800	8,390	

Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for 1892–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.												
21			20,200	24,900	35,300	9,790	14,700	10,800	41,300	38,000	7,170	
22			21,400	23,600	34,200	9,540	14,400	10,800	42,500	35,800	6,800	
23			21,400	22,300	32,600	9,300	14,400	10,300	42,500	33,200	6,800	
24			22,300	21,800	30,100	9,060	14,000	10,000	42,500	31,100	7,360	
25			23,200	20,600	29,200	8,610	13,700	9,540	41,300	29,200	7,970	
26			24,000	19,800	28,700	8,390	12,600	9,060	39,100	27,200	8,830	
27			24,000	19,400	28,700	8,180	12,600	8,610	36,900	25,400	10,300	
28			24,000	19,400	29,600	7,970	12,000	8,390	34,200	24,000	12,000	
29			23,200	19,000	29,600	7,970	11,700	8,830	31,600	22,700	13,000	
30			21,800	19,000	29,600	7,560	11,700	9,060	28,700	21,000	11,400	
31			12,400		31,100		12,000	8,610		19,800		
1904.												
1				14,000	24,000	13,700	12,000	7,760	6 620	7,170	16,600	
2				13,300	23,600	13,300	12,000	7,760	6,440	7,760	15,500	
3				13,000	22,700	13,700	11,700	7,560	7,970	7,970	14,400	
4				14,000	21,800	14,400	11,700	7,360	9,300	8,180	13,300	
5				15,500	20,600	15,500	11,400	7,170	9,790	7,760	13,000	
6				16,600	20,200	15,800	11,100	7,170	10,300	7,560	12,600	
7				24,500	20,200	17,800	10,800	6,980	11,700	7,560	12,600	
8				26,300	20,600	19,400	10,800	6,620	12,000	7,970	12,300	
9				27,200	20,200	20,600	10,800	6,620	12,000	8,180	11,400	
10				30,600	19,800	21,400	11,400	6,800	12,000	8,830	10,600	
11				31,600	19,400	21,800	11,100	6,800	12,000	9,300	10,800	
12				31,600	20,200	21,400	10,600	6,800	11,400	14,000	10,800	
13				31,100	20,600	21,000	10,000	6,800	10,600	14,700	10,300	
14				30,100	20,200	20,600	9,790	6,800	9,540	14,700	10,000	
15				29,200	19,800	19,800	9,300	6,800	8,610	16,200	10,000	
16				29,200	19,400	18,200	9,060	6,620	8,390	17,400	9,790	
17				28,200	18,600	17,000	8,830	6,440	8,180	18,200	9,540	
18				26,800	17,800	15,800	8,610	6,270	7,970	17,800	9,060	
19				25,800	17,400	14,400	8,610	6,100	7,560	17,800	9,060	
20				24,900	17,000	13,300	8,610	6,620	7,360	18,600	8,830	
21				24,500	16,200	12,600	8,390	6,980	6,980	19,000	8,610	
22				23,600	15,800	12,300	8,180	7,170	6,800	20,600	8,610	
23				23,600	15,500	11,700	8,390	7,760	6,620	21,400	8,390	
24				23,200	15,100	11,400	8,390	8,180	6,620	20,600	8,390	
25				23,200	15,100	11,400	8,180	8,390	6,620	21,000	8,390	
26				23,200	15,100	11,100	7,970	8,180	6,440	21,400	8,390	
27				24,500	15,100	11,400	7,760	8,390	6,440	21,800	8,180	
28				24,900	15,500	11,700	7,560	8,390	6,800	21,800	8,180	
29				25,400	15,500	12,300	7,360	8,390	6,800	20,600	7,970	
30				24,900	14,700	12,000	7,560	7,760	6,620	19,400	7,560	
31					14,000		7,760	7,170		17,800		
1905.												
1			2,500	10,800	8,390	21,000	40,800	21,800	15,800	14,400	12,600	
2			2,600	10,800	8,180	19,000	40,200	20,600	15,100	14,000	12,300	
3			2,700	10,800	8,180	18,200	40,800	19,800	15,100	13,300	12,000	
4			2,800	11,100	8,390	18,200	41,300	19,400	14,700	13,300	12,000	
5			3,000	12,600	9,300	18,600	43,000	19,400	14,700	13,300	11,700	
6			5,000	12,000	10,800	18,600	45,900	19,800	14,400	13,000	12,000	
7			12,600	14,000	15,500	20,200	49,400	18,600	14,400	13,000	12,600	
8			11,700	16,200	18,600	22,300	53,600	18,600	14,000	12,600	12,600	
9			11,100	17,000	17,800	23,200	56,700	18,600	14,000	12,300	13,000	
10			13,000	17,400	17,800	23,200	58,500	18,600	14,000	12,300	13,300	
11			10,800	17,400	19,400	24,500	59,800	19,000	13,300	12,000	13,000	
12			8,830	17,400	22,700	24,500	59,200	19,000	13,300	12,000	13,300	
13			8,180	15,800	25,800	24,000	57,900	18,600	13,000	11,700	12,600	
14			7,760	15,100	26,800	24,000	56,700	18,600	12,600	11,400	12,600	
15			7,560	14,000	32,200	23,200	54,800	18,600	13,700	11,400	12,300	
16			7,760	13,700	36,400	22,700	53,000	18,600	13,700	11,100	12,000	
17			7,760	12,000	38,500	24,900	50,000	19,000	14,000	10,800	11,700	
18			7,760	11,700	41,300	26,800	47,100	22,300	13,700	11,700	11,400	
19			7,560	11,100	41,300	29,600	44,800	22,700	16,600	12,300	11,400	
20			7,560	10,800	40,800	32,600	41,900	22,700	18,600	12,600	11,100	
21			8,390	10,600	40,200	34,200	39,600	23,600	20,200	13,300	11,100	
22			9,300	10,000	38,500	34,700	38,000	22,300	19,800	13,700	10,800	
23			10,800	9,790	37,400	34,200	35,800	21,800	19,400	14,400	10,800	
24			12,000	9,300	36,400	33,700	34,200	21,000	18,600	14,400	10,800	
25			12,300	8,830	35,300	33,700	32,600	20,600	18,200	14,400	11,400	

Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for 1892–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
26			12,600	8,610	33,700	34,200	31,100	20,600	17,400	14,700	12,300	
27			13,300	8,610	31,600	35,800	29,600	19,400	16,600	14,400	12,600	
28			14,400	8,390	29,200	38,000	29,200	18,200	15,800	14,000	13,300	
29			12,600	8,390	27,200	39,600	27,200	17,400	15,500	13,700	14,400	
30			11,400	8,390	25,400	40,800	25,800	17,000	14,700	13,700	13,000	
31			10,800		23,200		23,600	16,200		13,300		
1906.												
1				20,600	27,200	43,000	33,700	14,700	24,500	22,700	21,800	
2				19,400	26,300	43,000	33,700	14,400	24,500	22,300	22,300	
3				21,800	26,800	43,000	34,200	14,000	23,600	21,400	22,300	
4				24,000	26,800	41,900	34,700	13,300	22,700	21,000	21,800	
5				27,200	26,300	41,300	34,700	13,000	21,800	20,200	21,400	
6				32,200	26,300	41,900	35,300	12,600	21,000	19,400	21,000	
7				33,200	25,400	43,600	34,200	12,600	20,200	18,600	21,000	
8				37,400	24,500	44,800	33,200	12,300	19,400	17,800	21,000	
9				39,600	24,500	45,900	32,200	13,700	18,600	17,000	21,000	
10				38,500	24,500	47,100	31,100	16,200	17,800	15,800	21,000	
11				36,900	23,600	49,400	29,600	17,400	17,400	15,400	20,600	
12				36,900	22,700	50,600	28,200	17,800	16,600	15,100	20,200	
13				36,400	23,200	50,000	27,200	17,400	16,600	14,400	19,800	
14				36,900	22,700	48,800	25,400	17,400	16,200	14,000	19,400	
15				38,500	22,300	46,500	24,000	17,400	15,800	13,300	18,600	
16				40,200	21,800	44,200	22,700	17,800	15,800	13,000	18,200	
17				41,900	21,400	41,900	21,800	18,200	15,500	12,600	18,200	
18				42,500	21,000	39,100	20,600	18,200	15,500	12,000	18,600	
19				43,000	20,600	36,900	19,800	17,800	15,500	11,700	16,600	
20				42,500	20,600	35,300	19,000	17,400	15,500	11,700	15,500	
21				41,900	21,400	35,300	18,200	16,600	16,600	11,700	13,700	
22				40,200	24,500	34,700	17,800	15,800	17,000	11,400	13,000	
23				38,500	27,200	34,200	17,000	16,600	18,600	11,400	12,000	
24				36,900	31,100	33,700	16,600	17,400	19,400	12,000	12,000	
25				35,300	32,200	33,200	15,500	17,800	21,000	13,300	11,400	
26				33,700	33,700	33,200	15,100	19,400	22,700	15,100	13,700	
27				32,200	36,400	32,600	14,400	21,000	23,600	17,000	14,400	
28				30,100	38,500	33,200	14,700	22,300	24,000	18,200	15,100	
29				29,200	40,800	33,200	15,500	23,200	23,600	19,000	15,500	
30				27,700	41,900	33,700	15,100	24,000	23,200	20,600	15,800	
31					43,000		15,100	24,500		21,400		
1907.												
1				48,800	19,800	26,800	32,600	10,600	12,000	11,400	8,390	
2				50,000	20,200	26,800	31,600	13,000	11,700	11,400	8,610	
3				49,400	20,200	26,300	31,100	12,600	10,800	11,400	8,610	
4				50,600	19,800	25,400	29,200	12,300	10,600	11,400	8,830	
5				48,800	19,000	24,500	27,200	11,700	10,300	11,700	8,830	
6				47,600	18,200	24,000	25,400	11,100	10,300	11,100	9,060	
7				47,100	17,400	23,200	24,500	11,100	9,300	10,800	9,300	
8				46,500	17,400	22,300	23,200	10,800	8,610	10,800	9,060	
9				44,200	17,400	21,400	22,300	11,100	8,390	10,600	9,060	
10				42,500	16,600	21,000	23,200	11,100	8,390	10,600	8,830	
11				41,300	16,200	23,600	17,800	10,600	8,390	10,300	8,830	
12				40,800	15,500	26,800	16,200	10,300	8,180	10,000	8,610	
13				39,100	15,500	29,600	15,100	9,540	7,970	10,000	8,610	
14				38,000	15,100	32,200	14,700	10,300	7,970	9,540	8,390	
15				36,400	14,700	34,200	15,800	9,790	7,970	9,300	7,360	
16				33,700	15,500	35,300	15,500	9,300	7,970	9,060	7,360	
17				32,200	15,800	36,900	15,500	10,000	8,180	9,060	7,560	
18				30,600	15,800	37,400	15,500	9,790	9,300	8,830	7,760	
19				29,200	15,800	37,400	15,500	10,000	10,000	8,830	7,360	
20				28,200	15,500	36,900	15,500	10,600	11,400	8,830	7,360	
21				27,200	15,500	36,400	15,500	11,700	12,300	8,830	7,560	
22				25,800	15,800	36,400	15,800	13,000	13,700	8,830	7,560	
23				24,900	15,800	36,400	15,500	13,000	14,700	8,610	7,560	
24			25,400	24,000	15,500	36,400	15,500	12,600	15,500	8,610	7,560	
25			26,300	22,700	15,500	36,900	17,400	12,000	15,800	8,830	7,170	
26			27,700	22,300	17,000	36,400	16,600	11,400	15,800	8,830	6,980	
27			32,600	21,800	18,600	35,400	16,200	11,100	14,700	8,830	6,800	
28			38,000	20,600	20,600	35,800	15,800	11,100	13,700	8,830	6,800	
29			39,100	20,600	22,700	35,800	15,500	11,400	13,000	8,610	6,980	
30			41,900	19,800	24,900	34,200	14,700	11,400	12,000	8,390	6,440	
31			44,800		25,800		14,400	12,300		8,390		

Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for 1892–1910— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1				15,300	20,900	52,500	70,400	20,500	9,030	9,270	9,270	
2				13,600	21,400	58,000	67,700	19,700	9,520	9,270	9,270	
3				12,700	21,400	61,900	64,400	18,900	9,270	9,270	9,270	
4				13,300	20,900	63,200	61,200	17,400	9,270	9,270	9,270	
5				13,300	19,700	62,500	57,400	17,000	9,270	9,270	9,030	
6				13,600	19,700	60,600	54,300	16,300	9,520	9,030	9,030	
7				13,600	18,200	58,000	51,300	15,600	9,270	9,270	9,030	
8				13,900	17,000	57,400	48,400	15,300	8,560	9,270	9,030	
9				14,200	16,000	54,900	47,200	14,600	8,560	9,270	9,270	
10				13,900	15,300	56,200	45,000	13,600	8,340	9,270	7,910	
11				13,900	14,900	57,400	42,200	12,400	7,910	8,790	7,700	
12				13,900	14,200	58,700	41,100	13,300	7,700	8,560	8,120	
13				13,900	14,900	60,600	39,500	12,700	8,560	8,560	7,700	
14				13,600	14,600	61,200	37,900	12,000	7,700	8,790	7,300	
15				13,600	15,600	60,000	35,800	11,800	7,700	8,340	7,300	
16			9,030	13,300	17,000	58,000	34,300	10,900	7,300	8,120	7,300	
17			8,560	12,700	18,500	55,600	33,300	10,900	7,500	8,120	7,110	
18			8,120	12,700	19,300	52,500	32,800	10,600	8,120	7,910	6,920	
19			10,300	12,400	19,700	50,700	31,400	11,200	8,120	7,300	6,740	
20			9,780	12,400	20,500	48,400	30,400	10,900	9,910	8,120	6,740	
21			9,780	11,800	22,600	46,100	29,000	10,600	7,700	8,120	6,740	
22			10,600	13,000	23,900	44,400	28,500	10,300	7,500	8,120	6,560	
23			10,600	12,400	24,400	44,400	28,000	9,780	8,340	8,120	6,560	
24			11,200	12,400	25,700	44,400	27,100	9,520	8,340	8,120	6,560	
25			11,800	12,700	28,500	45,000	26,200	9,520	8,560	8,340	6,500	
26			12,700	13,600	29,900	48,900	24,800	9,270	7,700	8,340	6,500	
27			12,700	14,900	32,300	59,300	23,500	9,270	8,560	9,030	6,500	
28			13,600	16,300	35,300	69,700	21,800	9,520	8,120	9,270	6,300	
29			13,900	18,200	38,400	73,000	21,400	9,270	8,340	9,030	6,300	
30			14,600	19,700	42,200	72,400	21,800	9,270	9,030	9,520	6,100	
31			14,600		46,100		20,900	9,030		9,520		
1909.												
1				35,300	20,900	18,900	20,100	10,600	11,500	8,560	6,920	
2				40,000	20,900	20,900	20,900	10,300	10,900	8,560	7,300	
3				45,500	20,500	22,600	20,900	9,520	10,900	8,560	7,500	
4				48,900	20,500	23,900	20,500	9,270	10,300	8,120	7,110	
5				48,900	20,900	24,400	20,900	9,030	10,000	7,910	7,500	
6				47,800	20,900	25,700	20,900	9,030	9,520	7,700	8,340	
7				47,200	20,900	26,600	20,500	8,340	9,270	7,910	8,790	
8				46,100	21,800	27,100	20,100	8,340	9,270	7,910	8,790	
9				44,400	21,800	25,700	19,700	8,340	9,030	7,700	8,560	
10				42,700	21,800	25,300	18,500	8,340	8,790	7,700	8,340	
11				42,200	21,400	24,400	17,400	8,340	8,340	8,340	8,340	
12				40,000	20,900	23,100	17,400	8,340	8,120	8,120	7,910	
13				37,900	20,100	21,800	16,700	9,520	9,030	8,560	8,120	
14				35,300	19,300	22,600	15,300	10,900	9,520	8,340	8,120	
15			12,000	33,800	18,500	23,500	14,200	13,600	9,270	8,120	8,560	
16			12,400	31,800	18,500	23,500	12,700	14,600	8,790	7,910	9,030	
17			13,300	30,400	18,200	23,900	12,700	16,000	8,560	7,910	9,270	
18			12,700	29,400	18,200	24,400	12,400	16,700	8,340	7,700	9,270	
19			11,500	28,500	18,500	23,900	11,500	16,700	8,120	7,700	9,030	
20			10,600	27,100	18,500	23,500	10,900	16,700	7,700	7,700	9,030	
21			10,900	26,200	18,500	23,100	10,900	16,300	7,700	7,700	10,000	
22			10,300	24,800	18,500	22,600	10,900	15,600	8,790	7,500	10,000	
23			10,900	24,400	18,500	21,800	11,500	14,600	9,520	7,700	10,000	
24			12,000	23,500	18,500	20,900	11,500	13,900	9,780	7,700	10,000	
25			13,900	22,600	18,500	20,100	13,600	13,600	9,520	7,910	10,000	
26			14,900	22,200	18,500	20,100	13,900	13,600	9,520	7,700	10,000	
27			17,000	21,800	18,500	20,100	13,300	13,300	9,520	7,910	10,000	
28			22,600	21,400	18,500	20,100	13,000	13,000	9,520	7,700	10,000	
29			24,800	20,900	18,500	20,100	12,700	12,700	9,270	7,910	10,000	
30			26,600	20,900	18,900	20,100	12,400	12,000	8,560	7,910	9,000	
31			30,900		18,900		11,500	11,500		7,110		
1910.												
1			4,650	19,300	12,400	7,700	4,940	3,650	3,990	4,110	3,320	
2			4,700	17,800	12,000	7,300	5,240	3,650	3,990	4,110	3,320	
3			4,800	17,000	10,900	7,300	4,790	3,870	4,110	4,110	3,540	
4			5,000	15,600	10,300	7,700	4,510	3,870	4,240	4,110	4,240	
5			6,000	15,300	10,000	7,300	4,650	3,650	4,110	4,510	4,110	

Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for 1892–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910.												
6			7,000	14,200	9,780	7,300	4,370	3,650	3,990	4,510	4,240	.....
7			8,006	14,200	9,780	7,300	3,990	3,760	3,990	5,090	4,140	.....
8			10,900	14,200	9,780	7,300	3,870	3,760	4,110	5,240	4,140	.....
9			13,600	14,600	9,520	7,300	3,870	3,870	4,110	5,240	4,140	.....
10			15,600	13,900	9,520	7,300	4,370	3,760	4,110	5,090	3,990	.....
11			18,500	13,600	9,520	7,300	3,990	3,650	4,110	4,940	3,870	.....
12			20,500	13,600	9 270	6,920	3,990	3,650	3,990	4,940	3,540	.....
13			19,300	13,000	9,030	6,050	4,110	3,760	4,110	4,790	3,430	.....
14			21,400	12,700	9,030	6,740	3,990	3,760	3,990	4,790	3,320	.....
15			27,100	12,700	8,790	6,390	3,990	3,760	3,990	4,790	3,650	.....
16			29,900	12,000	8,340	6,050	4,110	3,870	4,110	4,790	3,540	.....
17			32,300	11,800	8,120	5,560	3,990	3,870	4,110	4,510	3,320	.....
18			34,300	11,800	8,560	6,050	3,870	3,870	4,110	3,990	3,210	.....
19			35,800	11,800	8,560	5,720	3,870	3,870	4,110	3,870	2,690	.....
20			34,800	11,800	8,790	5,560	3,760	3,990	4,110	3,870	2,790	.....
21			35,800	12,700	8,790	5,560	3,650	4,110	4,110	3,870	2,890	.....
22			34,800	13,000	9,030	5,400	3,650	3,990	4,110	3,870	3,100	.....
23			33,800	13,300	8,340	5,240	3,650	4,110	3,990	3,870	3,100	.....
24			32,300	13,300	9,030	4,940	4,240	3,990	3,990	3,760	2,990	.....
25			29,400	13,600	9,030	5,240	3,760	3,990	3,990	3,760	2,990	.....
26			26,600	13,600	8,120	5,240	3,650	3,990	3,990	3,870	2,990	.....
27			25,700	13,900	9,030	5,240	3,550	3,990	3,990	3,650	2,990	.....
28			23,900	13,600	8,120	5,240	3,550	3,990	3,990	3,650	2,990	.....
29			22,600	13,300	8,560	5,090	3,550	3,870	3,990	3,550	2,950	.....
30			21,400	12,700	8,120	4,650	3,870	3,870	4,110	3,550	2,900	.....
31			20,500	.....	7,700	.....	3,870	3,870	.....	3,350	.....	.....

Monthly discharge of Mississippi River at St. Paul, Minn., for 1892–1910.

[Drainage area, 35,700 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1892.					
March	10,600	4,000	6,940	0.194	0.22
April	12,700	6,620	9,350	.262	.29
May	45,700	8,520	24,300	.682	.79
June	39,500	24,900	29,000	.812	.91
July	23,900	9,400	13,700	.384	.44
August	16,000	6,960	10,000	.280	.32
September	8,520	6,280	7,350	.206	.23
October	6,640	5,200	5,930	.166	.19
November	5,060	.....	4,360	.122	.14
1893.					
April	44,500	18,900	31,900	.894	1.00
May	58,800	30,200	43,500	1.22	1.41
June	29,200	8,840	15,800	.443	.49
July	8,410	4,900	7,040	.197	.23
August	5,400	4,130	4,710	.132	.15
September	6,280	5,560	5,940	.166	.19
October	6,280	5,560	5,990	.168	.19
November	6,100	2,440	4,560	.128	.14
1894.					
March	9,070	4,000	6,590	.185	.21
April	34,800	5,920	15,600	.437	.49
May	41,200	19,400	29,000	.812	.94
June	18,000	5,740	9,650	.270	.30
July	5,740	1,920	4,020	.113	.13
August	4,430	1,920	3,430	.096	.11
September	4,280	3,540	3,930	.110	.12
October	4,740	3,840	4,260	.119	.14
November	4,740	2,980	4,060	.114	.13
December	.....	.....	[a] 2,790	.078	.09

[a] Estimated.

Monthly discharge of Mississippi River at St. Paul, Minn., for 1892–1910—Continued.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1895.					
January	1,900	1,200	1,540	0.043	0.05
February	.....	.....	a 1,300	.036	.04
March (22–31)	4,110	2,630	3,420	.096	.04
April	3,860	2,750	3,420	.096	.11
May	5,640	3,230	4,540	.127	.15
June	9,640	4,640	7,440	.208	.23
July	7,900	4,240	5,720	.160	.18
August	5,340	3,370	4,410	.124	.14
September	5,640	4,240	4,860	.136	.15
October	5,500	3,860	4,690	.131	.15
November	4,240	2,990	3,760	.105	.12
1896.					
March (10–31)	3,230	1,420	2,060	.058	.02
April	35,300	2,280	19,900	.557	.62
May	34,300	21,600	28,100	.787	.91
June	27,300	13,700	20,300	.569	.63
July	12,700	4,640	7,740	.217	.25
August	5,800	4,500	5,050	.141	.16
September	5,340	3,980	4,800	.134	.15
October	5,640	4,640	5,020	.141	.16
November	6,440	4,000	5,080	.142	.16
December	5,000	4,150	4,410	.124	.14
1897.					
January	5,340	3,050	4,300	.120	.14
February	3,550	3,120	3,340	.094	.10
March	48,900	3,000	11,200	.314	.36
April	80,800	31,300	59,300	1.66	1.85
May	29,800	10,400	16,600	.465	.54
June	15,600	10,200	12,800	.359	.40
July	49,600	14,400	32,200	.902	1.04
August	24,600	8,500	14,100	.395	.46
September	11,800	8,500	9,910	.278	.31
October	10,100	7,600	8,180	.229	.26
November	7,800	4,700	6,700	.188	.21
1898.					
March	8,730	4,000	6,980	.195	.22
April	8,520	6,440	7,670	.215	.24
May	10,600	6,280	7,740	.217	.25
June	35,300	9,880	19,800	.555	.62
July	17,200	8,100	11,200	.314	.36
August	7,900	5,960	6,680	.187	.22
September	6,790	5,960	6,340	.178	.20
October	9,640	6,120	8,020	.225	.26
November	8,100	5,000	6,680	.187	.21
1899.					
April	34,300	8,000	19,500	.546	.61
May	20,200	12,700	15,200	.426	.49
June	36,800	12,700	30,100	.843	.94
July	25,400	8,300	14,500	.406	.47
August	25,800	7,330	12,500	.350	.40
September	19,800	9,400	12,600	.353	.39
October	25,800	8,300	14,600	.409	.47
November	18,500	10,100	13,100	.367	.41
December (1–9)	9,880	5,640	8,260	.231	.08
1900.					
January	.....	.....	a 3,950	.111	.13
February	.....	.....	a 3,100	.087	.09
March	.....	.....	a 3,500	.098	.11
April	12,300	6,440	8,900	.249	.28
May	7,900	5,640	6,670	.187	.22
June	6,790	3,370	4,630	.130	.14
July	6,440	3,260	5,160	.145	.17
August	12,000	3,610	7,060	.198	.23
September	13,700	8,100	11,400	.319	.36
October	16,000	8,950	11,800	.331	.38
November	9,640	3,980	6,950	.195	.22
December	.....	.....	a 3,500	.098	.11
The year	16,000	.....	6,380	.179	2.44

a Estimated.

Monthly discharge of Mississippi River at St. Paul, Minn., for 1892–1910—Continued.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1901.					
January			[a] 2,250	0.063	0.07
February			[a] 2,200	.062	.06
March	13,000		[a] 6,550	.183	.21
April	19,800	11,700	15,500	.434	.48
May	18,900	10,900	15,400	.431	.50
June	14,400	8,300	10,200	.286	.32
July	18,500	8,100	14,100	.395	.46
August	7,900	5,340	6,100	.171	.20
September	6,120	4,920	5,490	.154	.17
October	6,620	5,500	5,940	.166	.19
November	6,120	3,980	5,100	.143	.16
December			[a] 3,000	.084	.10
The year	19,800		7,650	.214	2.91
1902.					
January			[a] 2,950	.083	.10
February			[a] 2,950	.083	.09
March	6,120	3,000	4,430	.124	.14
April	5,200	3,860	4,530	.127	.14
May	19,800	4,780	10,200	.286	.33
June	16,800	9,880	13,600	.381	.43
July	9,880	5,640	7,690	.215	.25
August	7,140	4,110	5,060	.142	.16
September	6,620	4,240	5,340	.150	.17
October	5,340	4,500	4,900	.137	.16
November	9,640	5,500	7,710	.216	.24
December			[a] 4,000	.112	.13
The year	19,800		6,110	.171	2.34
1903.					
January			[a] 2,850	.080	.09
February			[a] 2,300	.064	.07
March	24,000	2,000	13,200	.370	.43
April	26,800	18,200	21,300	.597	.67
May	36,900	17,800	26,500	.742	.86
June	42,500	7,560	19,000	.532	.59
July	21,400	7,170	15,100	.423	.49
August	15,800	8,390	11,800	.331	.38
September	42,500	8,390	24,900	.697	.78
October	51,800	19,800	34,800	.975	1.12
November	19,000	6,800	12,200	.342	.38
December			[a] 4,550	.127	.15
The year	51,800		15,700	.440	6.01
1904.					
January			[a] 3,520	.099	.11
February			[a] 2,730	.076	.08
March			[a] 4,600	.129	.15
April	31,600	13,000	24,200	.678	.76
May	24,000	14,000	18,400	.515	.59
June	21,800	11,100	15,600	.437	.49
July	12,000	7,360	9,540	.267	.31
August	8,390	6,100	7,250	.203	.23
September	12,000	6,440	8,550	.239	.27
October	21,800	7,170	14,900	.417	.48
November	16,600	7,560	10,400	.291	.32
December			[a] 3,980	.111	.13
The year	31,600		10,300	.289	3.92

[a] Estimated from records kept by the St. Anthony Falls Water Power Co. at Minneapolis.

Monthly discharge of Mississippi River at St. Paul, Minn., for 1892–1910—Continued.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1905.					
January	.....	.....	[a] 3,090	0.087	0.10
February	.....	.....	[a] 2,510	.070	.07
March	14,400	2,500	8,920	.250	.29
April	17,400	8,390	12,100	.339	.38
May	41,300	8,180	26,000	.728	.84
June	40,800	18,200	27,300	.765	.85
July	59,800	23,600	43,300	1.21	1.40
August	23,600	16,200	19,800	.555	.64
September	20,200	12,600	15,500	.434	.48
October	14,700	10,800	13,000	.364	.42
November	14,400	10,800	12,200	.314	.35
December	.....	.....	[a] 8,700	.244	.28
The year	59,800	.....	16,000	.447	6.10
1906.					
January	.....	.....	[a] 7,100	.199	.23
February	.....	.....	[a] 6,350	.178	.19
March	.....	.....	[a] 8,000	.224	.26
April	43,000	19,400	34,500	.966	1.08
May	43,000	20,600	27,400	.768	.89
June	50,600	32,600	40,500	1.13	1.26
July	35,300	14,400	24,200	.678	.78
August	24,500	12,300	17,200	.482	.56
September	24,500	15,500	19,500	.546	.61
October	22,700	11,400	16,100	.451	.52
November	22,300	11,400	17,900	.501	.56
December	.....	.....	[a] 9,900	.277	.32
The year	50,600	.....	19,100	.533	7.26
1907.					
January	.....	.....	[a] 8,480	.238	.27
February	.....	.....	[a] 8,050	.225	.23
March	44,800	8,000	15,500	.434	.50
April	50,600	19,800	35,200	.986	1.10
May	25,800	14,700	17,700	.496	.57
June	37,400	21,000	31,100	.871	.97
July	32,600	14,400	19,400	.543	.63
August	13,000	9,300	11,200	.314	.36
September	15,800	7,970	11,000	.308	.34
October	11,700	8,390	9,690	.271	.31
November	9,300	6,440	7,970	.223	.25
December	.....	.....	[a] 4,600	.129	.15
The year	50,600	.....	15,000	.420	5.68
1908.					
January	.....	.....	[a] 3,500	.098	.11
February	.....	.....	[a] 3,680	.103	.11
March	14,600	.....	[a] 7,800	.218	.25
April	19,700	11,800	13,800	.387	.43
May	46,100	14,200	22,900	.641	.74
June	73,000	44,400	56,500	1.58	1.76
July	70,400	20,900	38,700	1.08	1.24
August	20,500	9,030	12,600	.353	.41
September	9,520	7,300	8,380	.235	.26
October	9,520	7,300	8,730	.245	.28
November	9,270	6,100	7,600	.213	.24
December	.....	.....	[a] 5,350	.150	.17
The year	73,000	.....	15,800	.442	6.00

[a] Estimated from records kept by the St. Anthony Falls Water Power Co. at Minneapolis.

Monthly discharge of Mississippi River at St. Paul, Minn., for 1892–1910—Continued.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1909.					
January			[a] 3,500	0.098	0.11
February			[a] 3,500	.098	.10
March	30,900	4,000	10,400	.291	.34
April	48,900	20,900	33,700	.944	1.05
May	21,800	18,200	19,600	.549	.63
June	27,100	18,900	22,800	.639	.71
July	20,900	10,900	15,500	.434	.50
August	16,700	8,340	12,000	.336	.39
September	11,500	7,700	9,230	.259	.29
October	8,560	7,110	7,930	.222	.26
November	10,000	6,920	8,610	.241	.27
December			[a] 6,500	.182	.21
The year	48,900		12,800	.358	4.86
1910.					
January			[a] 5,100	.143	.16
February			[a] 4,650	.130	.14
March	35,800	4,650	21,300	.597	.69
April	19,300	11,800	13,800	.387	.43
May	12,400	7,700	9,220	.258	.30
June	7,700	4,650	6,270	.176	.20
July	5,240	3,550	4,040	.113	.13
August	4,110	3,650	3,850	.108	.12
September	4,240	3,990	4,060	.114	.13
October	5,240	3,350	4,260	.119	.14
November	4,240	2,690	3,410	.096	.11
December			[b] 2,250	.063	.07
The year	35,800		6,850	.192	2.62

[a] Estimated from records kept by the St. Anthony Falls Water Power Co. at Minneapolis.
[b] Estimated from United States engineer records at Lock and Dam 2, below Minneapolis.

NOTE.—From 1892 to 1899 the monthly mean values are considered good; from 1900 to 1908, fair; and for 1909 and 1910, good. All estimates during the frozen period are considered fair.

SANDY RIVER.

SANDY RIVER BELOW SANDY LAKE RESERVOIR, MINN.

This station is located 1 mile above the mouth of Sandy River at the Sandy Lake dam, near Libby post office, in Aitkin County. It was established July 7, 1893, and is maintained by the United States Engineer Corps for the purpose of measuring the flow from Sandy Lake reservoir, which is one unit in the Government reservoir system on the headwaters of the Mississippi. The area of the water surface of the reservoir at low stage is 8 square miles; at high stage the area is 16.5 square miles. These areas, with a range of 9.4 feet, give a capacity of about 3,157,900,000 cubic feet.

In connection with the records of the Mississippi above Sandy River and of Pine River below Pine River reservoir these records are of value in determining the power and navigation possibilities of the upper Mississippi River.

At extreme flood stages the Mississippi drowns out the dam and fills Sandy Lake reservoir as much as 3 feet higher than was intended.

If the Mississippi is at a fairly high stage and the dam is open, there is frequently a considerable reverse flow into the reservoir, but the amount of this flow has not been computed in the records.

The daily discharge is based upon the flow through the openings of the dam and also on frequent discharge measurements made by an employee who resides near the dam.

The daily discharge for this station has been compiled from unpublished records in the United States engineer office at St. Paul. The monthly estimates have been computed by the Geological Survey.

Daily discharge, in second-feet, of Sandy River below Sandy Lake reservoir, Minn., for 1893–1910.

[0=no flow from reservoir.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1893.												
1								0	124	0	42	127
2								0	124	0	220	121
3								0	93	0	258	107
4								0	67	0	250	90
5								0	0	0	250	89
6								0	0	0	138	66
7							238	0	0	0	146	66
8							219	365	0	0	192	68
9							208	368	0	0	202	80
0							203	361	0	0	148	71
11							188	348	0	0	0	51
12							185	348	0	0	0	51
13							131	381	0	0	89	57
14							0	455	0	0	249	51
15							0	439	0	0	341	51
16							0	293	0	0	331	57
17							36	0	0	0	287	57
18							80	0	0	0	274	47
19							79	0	0	0	298	47
20							116	0	0	0	260	46
21							433	0	0	0	245	46
22							429	0	0	0	224	34
23							420	0	0	0	194	53
24							244	0	0	0	176	26
25							0	59	0	0	172	35
26							0	193	0	0	162	35
27							210	214	0	0	176	26
28							349	164	0	0	152	26
29							459	170	0	31	151	26
30							436	152	0	75	153	26
31							447	81	.....	106	.....	26
1894.												
1	19	0	0	0	1,241	(a)	0	0	(a)	0	0	226
2	0	0	0	0	1,100	(a)	0	(a)	(a)	0	0	230
3	0	0	0	0	1,097	(a)	0	(a)	(a)	0	0	213
4	0	0	0	0	1,097	(a)	0	(a)	(a)	0	0	193
5	0	0	0	0	1,097	(a)	0	(a)	0	0	0	176
6	0	0	0	0	1,110	(a)	0	(a)	0	0	40	170
7	0	0	0	0	1,100	(a)	0	(a)	0	0	84	97
8	0	0	0	0	1,090	0	0	(a)	(a)	0	204	0
9	0	0	0	0	1,084	0	0	(a)	(a)	0	176	0
10	0	0	0	0	1,144	0	0	(a)	(a)	(a)	155	0
11	0	0	0	0	1,137	0	0	(a)	(a)	(a)	155	0
12	0	0	0	0	1,141	0	0	(a)	(a)	(a)	b— 84	0
13	0	0	0	0	1,111	0	0	(a)	(a)	(a)	0	0
14	0	0	0	0	1,091	0	0	(a)	(a)	(a)	0	0
15	0	0	0	0	992	0	0	(a)	0	(a)	0	0

a Dam open, but no record of discharge.

b Flow from river into reservoir.

Daily discharge, in second-feet, of Sandy River below Sandy Lake reservoir, Minn., for 1893–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1894.												
16	0	0	0	0	877	0	0	(a)	0	(a)	0	0
17	0	0	0	0	560	0	0	(a)	0	(a)	62	0
18	0	0	0	(a)	1,034	0	0	(a)	0	(a)	260	0
19	0	0	0	(a)	1,013	0	0	(a)	0	(a)	233	0
20	0	0	0	(a)	1,070	0	0	(a)	0	(a)	219	0
21	0	0	0	(a)	1,013	0	0	(a)	0	(a)	192	0
22	0	0	0	(a)	939	0	0	(a)	0	(a)	170	0
23	0	0	0	(a)	859	0	0	(a)	0	(a)	198	0
24	0	0	0	(a)	864	0	0	(a)	0	(a)	204	0
25	0	0	0	(a)	847	0	0	(a)	0	0	200	0
26	0	0	0	(a)	852	0	0	(a)	0	0	237	0
27	0	0	0	(a)	(a)	0	0	(a)	0	0	235	0
28	0	0	0	(a)	(a)	0	0	(a)	0	0	263	0
29	0	.....	0	(a)	(a)	0	0	(a)	0	0	254	0
30	0	.....	0	(a)	(a)	0	0	(a)	0	0	255	0
31	0	.....	0	.....	(a)	.....	0	(a)	.....	0	.....	0
1895.												
1	0	0	0	0	(a)	0	(a)	112	(a)	282	201	0
2	0	0	0	0	(a)	0	(a)	114	303	309	184	0
3	0	0	0	0	(a)	0	(a)	109	(a)	277	167	0
4	0	0	0	0	(a)	0	(a)	125	287	365	167	0
5	0	0	0	0	(a)	0	(a)	109	(a)	330	154	0
6	0	0	0	0	(a)	0	(a)	215	(a)	334	154	0
7	0	0	0	0	(a)	0	(a)	322	283	339	123	0
8	0	0	0	0	(a)	(a)	(a)	308	(a)	324	151	0
9	0	0	0	0	(a)	(a)	(a)	308	(a)	391	154	0
10	0	0	0	0	(a)	(a)	(a)	297	176	289	167	0
11	0	0	0	0	(a)	(a)	(a)	297	(a)	288	181	0
12	0	0	0	0	0	(a)	(a)	287	333	287	b— 53	0
13	0	0	0	0	0	(a)	(a)	302	329	275	0	0
14	0	0	0	0	0	(a)	(a)	277	305	263	0	0
15	0	0	0	0	0	(a)	(a)	298	(a)	261	0	0
16	0	0	0	0	0	(a)	(a)	277	(a)	262	109	0
17	0	0	0	0	0	(a)	(a)	137	274	263	83	0
18	0	0	0	0	0	(a)	(a)	137	(a)	261	15	0
19	0	0	0	0	0	(a)	(a)	137	(a)	275	0	0
20	0	0	0	0	0	(a)	(a)	138	(a)	272	0	0
21	0	0	0	0	0	0	(a)	139	(a)	269	b—260	0
22	0	0	0	0	0	(a)	(a)	139	(a)	203	b—318	0
23	0	0	0	0	0	(a)	(a)	140	(a)	210	0	0
24	0	0	0	0	0	(a)	(a)	141	(a)	211	0	0
25	0	0	0	0	0	(a)	(a)	142	(a)	213	0	0
26	0	0	0	0	0	(a)	(a)	142	263	249	0	0
27	0	0	0	0	0	(a)	(a)	143	289	247	0	0
28	0	0	0	(a)	0	(a)	(a)	144	290	246	0	0
29	0	.....	0	(a)	0	(a)	(a)	144	(a)	244	0	0
30	0	.....	0	(a)	0	0	(a)	145	(a)	242	0	0
31	0	.....	0	.....	0	.....	(a)	145	.....	230	.....	0
1896.												
1	0	152	0	0	1,012	1,073	0	623	0	468	0	0
2	0	160	0	0	768	1,075	0	174	802	404	0	0
3	0	163	0	0	771	1,095	0	150	791	388	0	0
4	0	112	0	0	782	1,153	0	124	780	372	0	0
5	0	111	0	0	727	1,255	0	101	770	356	0	0
6	0	107	0	0	522	1,347	252	345	756	400	0	0
7	0	109	0	0	460	1,438	1,161	357	742	351	59	0
8	0	108	0	0	506	1,442	142	438	728	351	510	0
9	0	100	0	0	549	1,448	0	420	735	351	531	41
10	0	97	0	0	592	1,534	0	403	743	308	573	329
11	0	96	0	0	642	1,514	85	408	750	281	581	379
12	0	98	0	0	675	0	0	444	727	267	405	362
13	0	97	0	0	711	0	86	346	704	188	399	341
14	0	95	0	0	720	0	0	0	682	203	369	322
15	0	92	0	0	629	0	0	451	659	240	342	302

a Dam open, but no record of discharge.

b Flow from river into reservoir.

Daily discharge, in second-feet, of Sandy River below Sandy Lake reservoir, Minn., for 1893–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1896.												
16	0	89	0	0	615	0	0	437	648	167	273	304
17	0	87	0	0	597	875	0	424	636	146	312	257
18	0	84	0	0	573	1,005	0	510	625	119	325	255
19	0	80	0	0	563	126	0	481	613	84	286	253
20	0	0	0	0	533	0	0	453	604	84	276	238
21	0	0	0	0	483	0	0	445	600	84	301	224
22	0	0	0	0	428	107	0	436	853	84	296	210
23	0	0	0	0	388	0	0	427	780	0	251	195
24	0	0	0	0	388	0	0	418	708	0	128	174
25	0	0	0	0	.....	0	0	465	696	0	0	153
26	0	0	0	0	.....	0	0	513	685	0	0	152
27	0	0	0	0	.....	0	0	299	673	0	0	151
28	0	0	0	0	.....	0	0	0	661	0	0	150
29	0	0	0	(a)	.....	0	0	0	597	0	0	149
30	0	.....	0	(a)	.....	0	10	0	532	0	0	148
31	0	.....	0	.....	.....	.....	216	0	.....	0	.....	148
1897.												
1	0	112	71	101	779	384	378	2,894	0	877	0	0
2	0	111	73	82	782	405	369	2,428	0	854	0	0
3	0	110	75	47	786	427	620	2,297	0	830	0	0
4	0	109	76	0	790	448	1,706	2,226	0	538	0	0
5	0	106	75	0	793	511	1,146	1,096	0	783	0	0
6	0	102	76	0	771	575	2,013	0	912	789	0	0
7	0	100	74	0	749	638	3,210	0	826	795	0	0
8	0	97	72	0	726	624	3,063	1	1,071	801	0	0
9	0	100	70	0	703	610	2,792	1	1,056	737	0	0
10	0	102	69	0	680	595	3,675	2	1,041	673	0	0
11	0	102	68	0	896	602	3,709	4	1,026	609	0	0
12	0	103	68	0	647	609	3,738	5	1,009	561	0	0
13	0	103	68	0	614	616	3,697	7	991	514	0	0
14	21	102	67	0	582	618	3,576	9	974	466	0	0
15	205	100	66	0	574	619	3,311	9	990	427	0	0
16	202	95	65	0	566	621	3,086	12	1,007	387	0	0
17	199	89	68	0	557	623	2,841	321	1,023	366	0	0
18	196	88	70	98	550	620	2,634	327	983	344	0	0
19	193	87	72	197	544	616	2,488	333	943	304	0	0
20	190	87	74	295	538	635	2,401	339	903	307	0	0
21	180	83	76	393	531	626	2,368	345	907	156	0	0
22	171	80	77	492	517	617	2,328	352	922	0	0	0
23	161	75	79	590	504	557	2,425	359	897	0	0	0
24	152	72	82	688	490	487	2,329	366	871	0	0	0
25	142	72	83	787	477	421	2,494	372	846	0	0	0
26	137	72	84	1,084	463	356	2,537	0	820	0	0	0
27	131	72	85	1,747	443	368	2,520	0	794	0	0	0
28	126	72	90	1,661	423	379	2,494	0	1,024	0	0	0
29	123	.....	96	1,575	402	368	2,510	0	975	0	0	0
30	119	.....	108	1,489	382	357	2,444	0	926	0	0	0
31	116	.....	120	.....	362	.....	2,700	0	.....	0	.....	0
1898.												
1	0	0	0	0	0	0	0	0	0	385	0	0
2	0	0	0	0	0	0	0	0	0	482	227	0
3	0	0	0	0	0	0	0	0	0	385	219	0
4	0	0	0	0	0	0	0	0	0	382	210	0
5	0	0	0	0	0	0	0	0	0	379	204	0
6	0	0	0	0	0	0	0	0	0	376	198	0
7	0	0	0	0	0	0	0	0	0	375	191	50
8	0	0	0	0	0	0	0	0	0	369	0	201
9	0	0	0	0	0	0	0	0	0	363	0	167
10	0	0	0	0	0	0	0	0	0	357	0	225
11	0	0	0	0	0	0	0	0	0	360	0	276
12	0	0	0	0	0	0	0	0	0	364	0	281
13	0	0	0	0	0	0	0	0	0	420	0	225
14	0	0	0	0	0	0	0	0	0	387	0	276
15	0	0	0	0	0	0	0	0	0	355	0	242
16	0	0	0	0	0	0	0	0	0	332	0	270
17	0	0	0	0	0	0	0	0	0	310	0	298
18	0	0	0	0	0	0	0	0	0	0	0	288
19	0	0	0	0	0	0	0	0	0	0	0	284
20	0	0	0	0	0	0	0	0	0	0	0	264

a Dam open, but no record of discharge.

Daily discharge, in second-feet, of Sandy River below Sandy Lake reservoir, Minn., for 1893–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1898.												
21	0	0	0	0	0	0	0	0	0	0	0	253
22	0	0	0	0	0	6	0	0	0	0	0	127
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0
29	0	.....	0	0	0	0	0	0	0	0	0	0
30	0	.....	0	0	0	0	0	0	0	0	0	0
31	0	.....	0	.....	0	.....	0	0	.....	0	.....	0
1899.												
1	0	0	0	0	0	0	1,474	0	1,149	0	1,607	0
2	0	0	0	0	0	184	1,451	0	1,115	0	1,497	0
3	0	0	0	0	0	632	1,429	0	1,119	0	1,428	0
4	0	0	0	0	0	573	1,206	0	568	0	1,223	0
5	0	0	0	0	0	847	709	0	585	0	1,332	0
6	0	0	0	0	0	359	300	0	580	0	1,279	0
7	0	0	0	0	0	379	0	0	576	0	1,239	0
8	0	0	0	0	0	637	788	0	572	0	1,191	0
9	0	0	0	0	0	963	768	0	571	0	1,141	0
10	0	0	0	0	0	815	604	0	564	0	1,098	0
11	0	0	0	0	0	506	0	0	555	0	1,053	0
12	0	0	0	0	0	357	0	0	324	0	1,005	0
13	0	0	0	0	0	145	0	0	328	0	1,072	0
14	0	0	0	0	0	357	0	0	328	0	1,027	0
15	0	0	0	0	0	357	0	0	327	646	636	0
16	0	0	0	0	0	887	0	0	332	594	0	0
17	0	0	0	0	0	686	0	152	337	863	0	0
18	0	0	0	0	0	901	0	820	345	968	0	0
19	0	0	0	0	0	903	0	604	349	1,159	0	0
20	0	0	0	0	198	983	0	567	353	2,888	0	0
21	0	0	0	0	727	899	0	702	353	2,072	0	0
22	0	0	0	0	806	1,059	0	918	354	1,154	0	0
23	0	0	0	0	0	978	0	1,244	354	1,716	0	0
24	0	0	0	0	0	974	0	2,073	0	1,684	0	0
25	0	0	0	0	314	967	0	2,099	0	1,635	0	0
26	0	0	0	0	1,257	1,034	0	2,065	0	1,571	0	0
27	0	0	0	0	114	1,336	0	2,067	0	1,490	0	0
28	0	0	0	0	0	1,318	0	2,026	0	1,369	0	0
29	0	.....	0	0	0	1,309	0	2,000	0	1,288	0	0
30	0	.....	0	0	0	1,499	0	1,123	0	1,703	0	0
31	0	.....	0	.....	0	.....	0	1,155	.....	1,622	.....	0
1900.												
1	0	0	0	0	0	454	153	0	0	0	0	0
2	0	0	0	0	0	394	149	0	0	300	0	0
3	0	0	0	0	0	446	155	0	0	0	0	0
4	0	0	0	0	0	552	149	0	0	0	0	0
5	0	0	0	0	318	536	119	0	0	0	0	0
6	0	0	0	0	822	473	127	0	0	0	0	0
7	0	0	0	0	873	329	113	0	0	0	0	0
8	0	0	0	0	867	271	123	0	0	0	0	0
9	0	0	0	0	1,041	293	64	0	0	0	0	0
10	0	0	0	0	1,004	299	29	0	0	556	0	0
11	0	0	0	0	955	301	0	0	0	474	0	0
12	0	0	0	0	931	354	79	0	0	0	0	0
13	0	0	0	0	892	387	104	0	0	0	0	0
14	0	0	0	0	743	363	0	0	0	0	0	0
15	0	0	0	0	725	272	75	0	(a)	0	0	0
16	0	0	0	0	685	221	57	0	(a)	0	0	0
17	0	0	0	0	655	235	0	0	(a)	0	0	0
18	0	0	0	0	766	297	0	0	(a)	0	0	0
19	0	0	0	0	738	278	0	0	(a)	0	0	0
20	0	0	0	0	714	85	0	0	(a)	0	0	0
21	0	0	0	0	700	278	0	0	(a)	0	0	0
22	0	0	0	0	668	204	0	0	(a)	0	0	0
23	0	0	0	0	628	203	0	0	(a)	0	0	0
24	0	0	0	0	616	136	0	0	(a)	0	0	0
25	0	0	0	0	566	139	0	0	(a)	0	0	0

[a] Dam open; water flowing from river into lake.

Daily discharge, in second-feet, of Sandy River below Sandy Lake reservoir, Minn., for 1893–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1900.												
26	0	0	0	0	551	0	0	0	(a)	0	0	0
27	0	0	0	0	522	0	0	0	0	0	0	0
28	0	0	0	229	501	42	0	0	0	0	0	0
29	0	0	0	0	580	49	0	0	0	0	0	0
30	0	.....	0	0	563	121	0	0	0	0	0	0
31	0	.....	0	.....	550	.....	0	0	.....	0	.....	0
1901.												
1	0	0	206	600	0	479	1,257	606	579	0	0	0
2	0	0	207	593	0	407	1,612	781	534	0	0	0
3	0	0	166	568	0	387	2,144	0	529	0	0	0
4	0	0	166	544	0	381	2,148	0	318	0	0	0
5	0	0	167	516	927	373	2,414	0	314	0	0	0
6	0	0	165	508	964	371	2,414	0	0	0	0	0
7	0	0	166	434	1,075	369	2,490	0	0	0	0	0
8	0	0	219	406	1,149	365	2,666	285	0	0	0	0
9	0	0	219	532	964	371	2,368	833	0	0	0	0
10	0	0	262	485	1,001	0	2,181	827	0	0	0	0
11	0	0	279	465	1,102	0	2,170	1,045	0	0	0	0
12	0	0	276	417	1,001	0	2,139	1,057	0	0	0	0
13	0	0	271	187	1,001	0	2,127	1,124	0	0	0	0
14	0	0	270	0	1,445	0	2,337	1,207	0	0	0	0
15	0	0	268	0	1,001	0	2,278	1,160		0	0	0
16	0	0	265	0	1,267	0	1,775	1,204	0	0	0	0
17	0	0	286	0	1,445	0	1,070	1,192	0	0	0	0
18	0	0	287	0	1,651	0	374	1,125	0	0	0	0
19	0	0	286	0	1,166	0	427	1,231	0	0	0	0
20	0	0	263	0	1,236	109	0	1,290	0	0	0	0
21	0	76	277	0	861	409	0	1,203	0	0	0	0
22	0	145	280	0	1,524	396	0	1,005	0	0	0	0
23	0	148	278	0	1,370	290	745	978	0	0	0	0
24	0	215	670	0	821	0	745	560	0	0	0	0
25	0	210	651	0	681	0	0	497	0	0	0	0
26	0	210	648	0	706	0	0	454	0	0	0	0
27	0	207	642	0	665	0	0	456	0	0	0	0
28	0	207	636	0	665	0	0	449	0	0	0	0
29	0	.....	643	0	640	927	0	442	0	0	0	0
30	0	.....	626	0	891	927	0	433	0	0	0	0
31	0	.....	614	.....	416	.....	0	593	.....	0	.....	0
1902.												
1	0	0	0	0	0	954	0	83	0	103	(a)	0
2	0	0	0	0	0	969	0	459	0	0	(a)	0
3	0	0	0	0	0	958	138	498	0	0	(a)	0
4	0	0	0	0	0	921	779	526	0	102	(a)	0
5	0	0	0	0	0	1,003	133	530	0	130	(a)	0
6	0	0	0	0	0	985	0	513	0	132	(a)	0
7	0	0	0	0	0	937	0	496	0	122	(a)	0
8	0	0	0	0	0	987	0	468	0	0	(a)	0
9	0	0	0	0	301	987	0	516	0	0	(a)	0
10	0	0	0	0	0	987	0	505	0	0	(a)	0
11	0	0	0	0	0	948	0	542	0	0	(a)	0
12	0	0	0	0	0	931	352	536	226	0	(a)	0
13	0	0	0	0	0	915	378	517	222	0	(a)	0
14	0	0	0	0	0	1,032	350	508	220	0	0	0
15	0	0	0	0	0	866	0	477	378	0	0	357
16	0	0	0	0	0	874	0	473	212	122	0	347
17	0	0	0	0	512	833	0	478	206	82	0	345
18	0	0	0	0	517	785	0	584	0	0	0	341
19	0	0	0	0	0	785	0	601	0	0	0	338
20	0	0	0	0	0	823	0	534	0	0	0	334
21	0	0	0	0	0	809	0	519	201	0	0	332
22	0	0	0	0	0	749	0	463	201	0	0	324
23	0	0	0	0	0	742	0	449	0	0	0	397
24	0	0	0	442	0	781	0	450	0	138	0	280
25	0	0	0	199	0	710	0	438	0	196	0	544
26	0	0	0	0	498	545	0	516	205	0	0	371
27	0	0	0	0	713	511	0	343	0	0	232	517
28	0	0	0	0	904	555	0	343	0	0	231	507
29	0	0	0	0	871	645	0	0	0	0	229	432
30	0	.....	0	0	923	481	0	0	207	0	0	422
31	0	.....	0	.....	959	.....	0	0	.....	0	.....	416

a Dam open; water flowing from river into lake.

Daily discharge, in second-feet, of Sandy River below Sandy Lake reservoir, Minn., for 1893–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.												
1	290	70	63	0	0	408	424	412	377	417	732	0
2	404	0	63	0	0	208	426	415	374	439	804	0
3	282	0	0	0	1,012	0	429	403	366	442	817	0
4	278	0	0	0	801	887	400	403	408	419	839	0
5	245	69	0	0	812	0	399	399	403	394	992	0
6	242	71	62	0	814	302	368	392	388	399	1,220	0
7	240	70	62	0	829	0	365	382	418	373	1,210	0
8	237	70	0	0	1,559	0	392	337	427	332	1,206	0
9	198	0	0	0	1,000	0	385	368	395	308	1,184	0
0	196	0	0	0	1,117	0	443	407	384	303	1,112	0
1	194	69	61	0	1,079	0	446	410	383	320	1,207	0
2	163	0	0	0	1,170	316	416	404	375	432	1,202	0
3	162	0	60	0	1,080	0	422	401	314	469	1,198	0
4	160	68	0	0	1,088	0	430	410	348	509	1,161	0
5	0	68	0	0	1,216	0	434	411	398	654	1,128	0
6	136	67	0	0	1,205	684	428	404	387	600	1,105	0
7	133	0	0	0	1,194	0	394	409	410	724	1,074	0
8	131	67	62	0	1,175	0	392	406	457	781	1,034	0
9	129	66	64	0	1,334	33	381	411	446	787	908	0
0	0	0	65	0	1,324	0	360	404	453	806	820	0
1	128	0	65	0	1,339	0	363	378	414	832	823	0
2	90	65	65	0	1,365	0	362	367	759	967	0	0
3	89	0	65	0	1,094	0	366	391	716	996	0	0
4	88	65	65	0	794	0	378	373	432	1,007	0	0
5	87	64	65	0	794	426	356	396	453	993	0	0
6	89	64	65	369	433	412	392	385	425	962	0	0
7	88	63	65	0	441	406	430	377	454	997	0	90
8	0	63	65	0	445	404	433	433	396	947	0	119
9	88	.....	66	0	366	437	431	429	399	971	0	119
0	71	.....	66	0	369	434	426	423	400	806	0	118
1	.....	.....	67	.....	375	.....	427	384	.....	743	.....	118
1904.												
1	118	120	208	92	1,204	623	0	0	257	89	131	196
2	131	151	204	91	935	303	0	0	276	87	156	192
3	161	152	200	91	933	723	0	0	269	85	123	192
4	157	151	198	123	925	795	0	326	268	145	123	194
5	156	149	178	167	923	703	0	308	301	136	128	195
6	157	135	173	276	907	822	0	282	329	133	119	190
7	156	134	177	0	903	608	0	268	0	133	115	190
8	153	133	166	0	495	382	0	127	0	128	127	189
9	158	131	161	0	578	588	0	356	0	123	131	190
0	157	141	157	0	786	824	0	359	0	128	129	193
1	154	139	168	0	786	819	0	331	0	133	129	189
2	153	137	164	313	881	1,015	0	231	0	0	133	184
3	152	121	245	362	928	915	0	0	0	0	130	186
4	151	119	232	527	919	864	0	0	0	0	129	186
5	149	118	227	661	915	728	0	0	0	0	133	185
6	144	117	192	714	906	208	0	0	0	0	133	162
7	139	118	178	674	842	448	0	0	106	0	137	165
8	145	116	170	651	791	0	0	0	317	144	139	165
9	144	115	163	556	817	0	0	0	319	151	153	190
0	143	120	154	508	877	0	0	304	316	160	147	189
1	143	170	152	413	1,012	0	0	293	302	166	146	186
2	142	198	132	492	889	0	0	288	279	168	132	186
3	141	190	124	592	619	0	0	144	217	178	134	165
4	139	195	116	712	523	0	0	0	177	170	136	165
5	138	190	134	296	521	0	0	0	366	566	202	162
6	131	183	126	0	329	0	0	0	259	677	203	172
7	129	184	113	307	438	0	0	0	181	322	203	169
8	129	176	99	943	552	0	0	292	181	0	202	159
9	121	174	97	814	480	0	0	282	128	0	201	169
0	120	.....	92	814	537	0	0	244	126	123	232	168
1	120	.....	92	.....	730	.....	0	259	.....	85	.....	168
1905.												
1	147	102	62	111	0	625	1,152	61	66	494	6	229
2	146	100	63	67	0	351	1,030	61	66	494	6	421
3	146	97	63	0	0	356	1,158	61	75	511	6	404
4	130	96	65	0	0	367	905	81	75	503	6	389
5	136	95	65	(*a*)	0	330	738	81	75	499	6	405

a Dam open; water flowing from river into lake.

Daily discharge, in second-feet, of Sandy River below Sandy Lake reservoir, Minn., for 1893–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
6	149	93	65	(a)	0	329	859	81	75	6	6	395
7	151	92	65	(a)	0	326	1,026	81	75	6	6	387
8	149	91	63	(a)	0	326	1,150	437	75	6	6	404
9	139	91	66	(a)	0	381	1,047	437	75	6	6	389
10	133	89	63	0	0	381	743	437	331	6	6	410
11	134	89	65	0	0	452	744	425	323	6	6	408
12	132	89	64	0	0	454	744	418	310	6	6	408
13	131	86	64	0	0	459	1,173	415	485	6	6	418
14	128	79	65	0	0	441	1,442	83	499	6	6	378
15	126	73	65	245	0	0	1,429	75	494	6	6	384
16	127	75	66	242	0	0	1,155	75	509	6	6	388
17	126	74	64	241	952	0	1,614	75	522	6	6	390
18	123	61	62	0	854	550	1,465	75	539	6	6	390
19	122	68	66	0	982	687	134	75	463	6	6	401
20	131	73	70	0	0	827	134	75	482	410	6	413
21	132	73	70	0	0	757	134	75	477	400	6	339
22	129	71	70	0	0	721	134	75	480	397	6	358
23	125	66	70	408	0	757	134	70	591	398	6	6
24	122	62	70	0	0	754	132	70	555	396	6	6
25	121	68	114	0	0	565	132	70	519	389	6	6
26	120	62	114	0	0	1,709	130	70	477	414	6	71
27	118	48	116	0	0	1,037	130	70	478	404	6	204
28	93	60	126	0	0	997	129	70	477	418	6	201
29	90	.....	137	0	0	1,010	958	68	499	418	6	129
30	104	.....	135	0	0	1,022	970	66	497	418	6	111
31	104	.....	143	.....	660	.....	787	66	.....	6	.....	110
1906.												
1	109	106	529	329	230	567	858	10	10	916	370	12
2	109	105	533	329	230	645	992	10	10	741	334	12
3	108	100	479	342	287	354	1,004	10	10	893	344	12
4	108	100	478	342	364	350	823	10	10	791	340	12
5	111	100	480	386	402	300	829	10	10	572	10	12
6	106	98	452	425	497	319	399	10	10	604	10	12
7	106	98	453	459	563	318	362	10	10	787	840	12
8	105	257	441	528	643	522	334	10	10	10	631	12
9	105	285	463	527	703	641	337	10	10	10	10	12
10	104	317	467	454	785	738	352	458	10	10	810	12
11	100	313	410	543	931	815	357	502	10	10	10	12
12	105	293	394	601	917	878	442	495	10	10	10	12
13	105	343	400	525	949	928	483	532	10	10	10	12
14	103	325	387	0	748	911	524	485	10	10	10	20
15	105	504	501	0	544	536	768	475	10	10	10	20
16	105	507	458	0	455	586	823	10	10	10	10	20
17	105	485	442	0	741	606	896	10	10	10	10	20
18	103	474	390	230	730	427	809	10	10	10	10	20
19	100	464	380	220	831	374	821	10	10	10	10	20
20	100	465	364	228	630	370	811	10	517	10	10	20
21	100	573	364	228	609	387	842	10	472	10	10	20
22	100	464	352	230	615	407	775	10	839	823	10	20
23	105	512	308	230	587	439	767	10	828	780	10	20
24	100	479	313	228	611	500	805	10	726	10	10	20
25	100	458	307	220	587	494	221	387	773	317	10	20
26	96	525	287	230	582	564	219	410	804	306	12	20
27	102	454	277	230	610	570	224	10	901	300	12	20
28	103	448	274	228	598	576	251	10	945	692	12	20
29	104	.....	274	230	381	696	10	10	1,016	695	12	20
30	103	.....	286	230	316	706	10	10	876	710	12	20
31	105	.....	315	.....	712	.....	10	10	.....	727	.....	20
1907.												
1	25	421	604	295	1,020	1,505	761	0	590	612	179	340
2	25	423	581	330	473	1,505	538	0	590	936	0	330
3	25	430	561	287	436	1,530	481	0	538	936	0	300
4	25	429	561	268	400	1,404	590	0	638	936	0	280
5	25	442	574	287	412	1,394	514	0	538	757	0	260
6	25	444	571	287	404	1,403	628	0	481	602	0	250
7	25	443	544	300	412	1,402	513	0	481	641	0	240
8	217	434	515	286	412	1,402	313	0	538	641	0	220
9	225	439	456	286	387	1,402	258	0	590	602	0	210
10	223	439	504	300	400	1,401	182	0	590	602	0	200

a Dam open; water flowing from river into lake.

Daily discharge, in second-feet, of Sandy River below Sandy Lake reservoir, Minn., for 1893–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
11	220	435	472	278	1,050	989	258	0	638	602	0	190
12	217	436	462	286	1,048	938	182	0	313	440	0	180
13	215	449	444	273	972	938	182	0	313	253	0	170
14	214	443	433	278	723	540	182	0	313	0	0	160
15	212	443	433	158	723	380	182	0	0	0	253	150
16	213	445	374	260	686	380	182	0	0	179	0	150
17	211	634	417	246	595	380	258	0	0	0	0	150
18	209	766	422	232	340	492	182	0	0	0	0	150
19	208	748	372	246	340	539	313	0	0	253	0	150
20	206	745	389	286	442	539	313	0	0	358	0	150
21	204	800	350	320	340	583	182	0	0	253	0	140
22	429	755	420	340	395	558	182	0	590	309	655	130
23	396	514	373	340	442	594	(a)	182	638	309	645	120
24	439	767	467	260	484	594	(a)	182	522	358	635	110
25	423	729	413	286	442	731	(a)	182	10	358	620	100
26	414	689	359	340	279	695	(a)	258	590	358	600	90
27	407	659	284	340	340	583	(a)	313	830	358	580	80
28	403	635	284	360	484	744	(a)	538	830	309	570	80
29	405	.....	274	473	523	761	(a)	481	864	309	550	80
30	403	.....	250	523	624	869	(a)	538	901	309	350	80
31	411	.....	238	.....	1,332	.....	(a)	481	.....	253	.....	80
1908.												
1	80	70	67	2	2	150	700	10	10	0	40	70
2	80	70	66	2	2	150	650	10	10	0	40	65
3	80	70	65	2	2	150	770	10	10	0	50	65
4	80	70	64	2	2	200	750	10	10	0	50	60
5	80	70	63	2	3	200	730	15	10	0	50	60
6	80	70	62	2	450	200	700	20	10	10	50	55
7	80	70	61	2	500	200	700	20	10	10	60	55
8	80	70	60	2	419	100	650	30	10	10	60	55
9	80	70	60	2	410	0	550	40	10	10	35	55
10	80	70	60	2	400	0	500	50	10	10	30	55
11	80	70	60	2	400	0	376	75	0	10	40	55
12	80	72	60	2	400	0	350	50	0	20	35	55
13	80	73	60	2	2	50	300	60	0	20	35	55
14	80	74	60	2	2	300	250	75	0	20	30	55
15	80	75	60	2	2	500	225	60	10	20	35	55
16	80	75	60	2	200	846	200	60	10	20	50	55
17	80	75	60	400	200	900	200	70	10	20	55	55
18	70	75	60	2	400	925	175	50	0	20	60	55
19	70	76	60	2	400	925	150	30	0	10	60	55
20	70	75	60	2	400	1,005	10	20	0	10	60	55
21	70	74	60	2	400	1,000	10	20	10	10	65	55
22	70	75	60	2	400	975	10	10	20	10	65	55
23	70	76	60	2	400	960	10	10	60	10	70	55
24	70	76	60	2	400	950	10	10	10	10	70	55
25	70	75	60	2	400	950	25	10	10	10	70	55
26	70	74	60	2	350	925	100	10	10	10	70	55
27	70	70	60	2	325	900	100	10	10	10	70	55
28	70	69	60	2	150	900	90	10	20	25	70	55
29	70	68	60	2	150	850	75	10	20	30	70	55
30	70	.....	60	2	150	800	50	10	10	30	70	55
31	70	.....	60	.....	150	.....	10	10	.....	35	.....	55
1909.												
1	55	35	35	20	20	360	40	550	750	0	0	50
2	55	35	35	10	25	320	100	479	900	0	0	50
3	55	35	35	10	30	320	179	420	900	20	0	60
4	55	35	35	20	40	320	170	420	900	20	0	80
5	55	35	35	20	20	477	160	420	900	50	0	80
6	55	35	35	10	10	477	145	400	800	40	0	90
7	55	35	35	15	15	465	130	300	800	80	0	90
8	55	35	35	15	30	465	0	300	700	90	0	85
9	55	35	35	20	40	470	0	200	602	150	0	85
10	55	35	35	15	60	475	0	200	550	200	0	80
11	50	35	35	15	75	475	0	0	700	250	0	65
12	50	35	25	20	80	312	0	0	750	320	0	60
13	50	35	0	20	80	312	0	0	500	250	0	60
14	50	35	0	20	125	310	55	0	300	330	0	60
15	40	35	15	30	291	300	20	40	250	350	0	60

[a] Dam open; water flowing from river into lake.

Daily discharge, in second-feet, of Sandy River below Sandy Lake reservoir, Minn., for 1893–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
16	35	35	15	35	310	300	50	30	200	351	400	70
17	30	35	15	40	310	290	60	100	100	300	700	80
18	30	35	15	40	310	300	40	75	150	100	650	85
19	30	35	0	40	320	249	20	75	150	0	600	90
20	30	35	0	40	330	249	15	75	200	0	0	95
21	30	35	0	40	300	250	15	30	175	0	0	95
22	30	35	15	15	290	245	20	30	50	0	0	95
23	30	35	20	35	300	240	30	15	0	20	0	95
24	30	35	20	40	290	235	20	0	0	0	30	100
25	30	35	20	40	290	230	10	0	0	0	0	100
26	30	35	0	40	285	20	180	15	0	0	0	100
27	30	35	0	40	285	0	460	100	0	0	0	100
28	35	35	15	40	280	0	550	220	0	0	60	100
29	35	.....	15	40	369	10	600	220	0	0	81	100
30	35	.....	15	30	369	20	500	250	0	0	45	100
31	35	.....	20	.....	360	.....	550	741	.....	0	.....	100
1910.												
1	100	75	20	160	260	0	(a)	(a)	0	0	0	10
2	100	75	20	160	250	0	0	(a)	0	0	0	10
3	100	75	25	175	320	0	0	(a)	0	0	0	10
4	100	75	25	180	290	20	0	(a)	0	0	0	10
5	100	75	25	200	330	20	0	(a)	0	0	0	10
6	100	75	25	200	360	20	(a)	(a)	0	0	0	10
7	100	75	25	290	340	20	(a)	(a)	0	0	175	10
8	100	75	25	390	350	10	(a)	(a)	0	0	150	10
9	100	75	25	390	340	10	(a)	(a)	0	0	150	10
10	95	75	25	390	340	10	(a)	(a)	0	0	150	10
11	95	70	25	390	360	10	(a)	(a)	0	0	17	10
12	95	70	0	390	340	10	(a)	(a)	0	0	0	10
13	95	70	0	400	330	10	(a)	(a)	0	0	0	10
14	95	70	0	400	437	10	(a)	(a)	0	0	0	10
15	95	70	0	400	415	10	(a)	(a)	0	0	0	10
16	95	70	0	504	400	10	(a)	(a)	0	0	0	10
17	100	70	0	500	0	10	(a)	(a)	0	0	0	10
18	100	70	0	480	(a)	10	(a)	(a)	0	0	0	10
19	100	70	0	475	(a)	10	(a)	(a)	0	0	0	10
20	90	65	0	470	(a)	10	(a)	(a)	0	0	0	10
21	90	65	0	445	(a)	10	(a)	(a)	0	0	0	10
22	90	65	0	420	(a)	10	(a)	(a)	0	0	0	10
23	90	60	0	390	(a)	10	(a)	(a)	0	0	0	10
24	90	60	0	370	(a)	10	(a)	(a)	0	0	0	10
25	90	50	0	360	(a)	(a)	(a)	(a)	0	50	0	10
26	80	35	0	360	(a)	(a)	(a)	(a)	0	0	0	10
27	80	20	80	360	20	(a)	(a)	(a)	0	0	0	10
28	80	20	150	360	20	(a)	(a)	(a)	0	0	0	10
29	80	.....	160	320	20	(a)	(a)	(a)	0	0	0	10
30	80	.....	170	269	0	(a)	(a)	0	0	0	0	10
31	80	.....	175	.....	0	.....	(a)	0	.....	0	.....	10

[a] Dam open; water flowing into river from lake.

Monthly outflow from Sandy Lake reservoir, Minn., for 1893–1910.

Month.	Discharge in second-feet.			Run-off (total in millions of cubic feet).
	Maximum.	Minimum.	Mean.	
1893.				
July (25 days)	459	0	204	441
August	455	0	142	380
September	124	0	13.6	35.2
October	106	0	6.8	18.2
November	341	0	193	500
December	127	26	56.7	152
The period	.....	.....	.....	1,530

Monthly outflow from Sandy Lake reservoir, Minn., for 1893–1910—Continued.

Month.	Discharge in second-feet.			Run-off (total in millions of cubic feet).
	Maximum.	Minimum.	Mean.	
1894.				
January	19	0	0.6	1.6
February	0	0	0	0
March	0	0	0	0
April (17 days)	0	0	0	0
May (26 days)	1,241	560	1,020	2,290
June (23 days)	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	263	0	127	329
December	230	0	42.1	113
The period				2,730
1895.				
January	0	0	0	0
February	0	0	0	0
March	0	0	0	0
April (27 days)	0	0	0	0
May (20 days)	0	0	0	0
June (9 days)	0	0	0	0
July	0	0	0	0
August	322	109	189	506
September (11 days)			285	271
October	365	210	275	736
November	201	0	67	174
December	0	0	0	0
The period				1,690
1896.				
January	0	0	0	0
February	163	0	70.2	176
March	0	0	0	0
April (28 days)	0	0	0	0
May (24 days)	1,012	388	610	1,260
June	1,534	0	550	1,430
July	1,161	0	63	169
August	623	0	326	873
September	853	0	676	1,750
October	468	0	184	493
November	581	0	207	537
December	379	0	169	453
The period				7,140
1897.				
January	205	0	89.2	239
February	112	72	93	225
March	120	65	77.3	207
April	1,747	0	378	980
May	896	362	601	1,610
June	638	356	531	1,380
July	3,738	369	2,500	6,690
August	2,894	0	455	1,220
September	1,071	0	791	2,050
October	877	0	391	1,050
November	0	0	0	0
December	0	0	0	0
The year	3,738	0	492	15,700
1898.				
January	0	0	0	0
February	0	0	0	0
March	0	0	0	0
April	0	0	0	0
May	0	0	0	0
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	482	0	206	552
November	227	0	41.6	108
December	298	0	120	321
The year	482	0	30.6	981

Monthly outflow from Sandy Lake reservoir, Minn., for 1893–1910—Continued.

Month.	Discharge in second-feet.			Run-off (total in millions of cubic feet).
	Maximum.	Minimum.	Mean.	
1899.				
January	0	0	0	0
February	0	0	0	0
March	0	0	0	0
April	0	0	0	0
May	1,257	0	110	296
June	1,499	0	761	1,970
July	1,474	0	282	755
August	2,099	0	633	1,700
September	1,149	0	572	1,480
October	2,888	0	788	2,110
November	1,607	0	594	1,540
December	0	0	0	0
The year	2,888	0	312	9,850
1900.				
January	0	0	0	0
February	0	0	0	0
March	0	0	0	0
April	229	0	7.6	19.8
May	1,041	0	619	1,660
June	552	0	267	692
July	155	0	48.3	129
August	0	0	0	0
September	0	0	0	0
October	556	0	42.9	115
November	0	0	0	0
December	0	0	0	0
The year	1,041	0	82.1	2,620
1901.				
January	0	0	0	0
February	215	0	50.6	122
March	670	165	344	921
April	600	0	208	539
May	1,651	0	891	2,390
June	927	0	219	568
July	2,660	0	1,220	3,270
August	1,290	0	711	1,900
September	579	0	75.8	196
October	0	0	0	0
November	0	0	0	0
December	0	0	0	0
The year	2,660	0	310	9,910
1902.				
January	0	0	0	0
February	0	0	0	0
March	0	0	0	0
April	442	0	21.4	55.4
May	959	0	200	536
June	1,032	481	834	2,160
July	779	0	68.7	184
August	601	0	431	1,150
September	378	0	75.9	197
October	196	0	36.4	97.5
November	232	0	40.7	56.3
December	544	0	213	570
The year	1,032	0	160	5,010
1903.				
January	404	0	155	415
February	71	0	40.7	98.5
March	67	0	41.3	111
April	369	0	12.3	31.9
May	1,559	0	891	2,390
June	887	0	179	464
July	446	356	403	1,080
August	433	337	398	1,070
September	759	314	425	1,100
October	1,007	303	649	1,740
November	1,220	0	726	1,880
December	119	0	18.2	48.7
The year	1,559	0	328	10,400

Monthly outflow from Sandy Lake reservoir, Minn., for 1893–1910—Continued.

Month.	Discharge in second-feet.			Run-off (total in millions of cubic feet).
	Maximum.	Minimum.	Mean.	
1904.				
January	161	118	143	383
February	198	115	147	368
March	245	92	160	428
April	943	0	373	967
May	1,204	438	770	2,060
June	1,015	0	379	982
July	0	0	0	0
August	359	0	151	404
September	366	0	166	430
October	677	0	136	364
November	232	115	148	384
December	196	159	180	482
The year	1,204	0	229	7,250
1905.				
January	151	90	128	343
February	102	48	79.4	192
March	143	62	79.2	212
April	408	0	43.8	114
May	982	0	111	297
June	1,709	0	566	1,470
July	1,614	129	762	2,040
August	437	61	141	378
September	591	66	355	920
October	511	6	228	611
November	6	6	6	15.6
December	421	6	302	809
The year	1,709	0	233	7,400
1906.				
January	111	96	104	279
February	573	98	345	835
March	533	274	395	1,060
April	601	0	292	757
May	949	230	593	1,590
June	928	300	551	1,430
July	1,004	10	553	1,480
August	532	10	128	343
September	1,016	10	296	767
October	916	10	349	935
November	840	10	130	337
December	20	12	16	42.8
The year	1,004	0	313	9,860
1907.				
January	439	25	235	629
February	800	421	551	1,330
March	604	238	432	1,160
April	523	158	302	783
May	1,332	279	560	1,500
June	1,530	380	906	2,350
July	761	182	238	637
August	538	0	102	273
September	901	0	431	1,120
October	936	0	414	1,110
November	655	0	188	487
December	340	80	172	461
The year	1,530	0	378	11,800
1908.				
January	80	70	75.5	202
February	76	68	72.3	181
March	67	60	60.9	163
April	400	2	15.3	39.7
May	500	2	251	672
June	1,005	0	533	1,382
July	770	10	304	814
August	75	10	28.6	76.6
September	60	0	10.3	26.7
October	36	0	13.2	35.3
November	70	30	53.8	139
December	70	55	56.5	151
The year	1,005	0	123	3,880

Monthly outflow from Sandy Lake reservoir, Minn., for 1893–1910—Continued.

Month.	Discharge in second-feet.			Run-off (total in millions of cubic feet).
	Maximum.	Minimum.	Mean.	
1909.				
January	55	30	41.8	112
February	35	35	35	84.7
March	35	0	19.7	52.8
April	40	10	27.2	71.1
May	369	10	192	514
June	477	0	283	734
July	600	0	133	356
August	741	0	184	493
September	900	0	378	980
October	351	0	94.2	262
November	700	0	85.6	222
December	100	50	82.6	221
The year	900	0	130	4,100
1910.				
January	100	80	93.1	252
February	75	20	65.0	157
March	175	0	32.3	86.5
April	504	160	353	915
May	437	0	178	477
June	20	0	8.3	21.8
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	50	0	16.1	4.3
November	175	0	21.4	55.5
December	10	10	10	26.8
The year	504	0	64.8	2,000

PINE RIVER.

PINE RIVER BELOW PINE RIVER RESERVOIR, MINN.

This station is located just below the dam at the outlet of Cross Lake, which is 15 miles above the mouth of Pine River, in the central part of Crow Wing County, in T. 137 N., R. 27 W.

It is maintained by the United States Engineer Corps for the purpose of measuring the flow from Pine River reservoir, the lowest unit in the present system of government reservoirs on the headwaters of the Mississippi.

In connection with the records of the Mississippi above Sandy River and of Sandy River below Sandy Lake reservoir, these records are of value in determining the availability of the upper Mississippi for power and navigation.

The dam is located at the outlet of Cross Lake and raises the water level in Cross, Pine, Daggett, Rush, Whitefish, Trout, and Hay lakes by varying amounts. The area of water surface at low water is 18 square miles; at high water the area is 24 square miles. These areas, with a range of 16.15 feet, give a capacity of 7,732,900,000 cubic feet.

Though the discharge of the dam represents the flow from the reservoir it does not represent the entire flow of Pine River at its

mouth, because between the two points the drainage area of the river is increased from 452 to 691 square miles by Little Pine River and one or two other minor tributaries.

The daily discharge is based upon daily gage heights representing the head at the dam and upon the various sized openings in the dam. These data have been compiled from unpublished records in the United States engineer office at St. Paul. The monthly estimates have been computed by the Geological Survey.

Daily discharge, in second-feet, of Pine River below Pine River reservoir, Minn., for 1895–1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1895.												
1	3	3	5	5	537	536	477	7	423	229	97	2
2	3	3	5	5	464	376	274	7	426	222	95	2
3	3	3	5	5	507	425	259	39	419	214	92	2
4	3	3	5	5	481	419	261	604	417	207	104	2
5	3	3	5	175	469	177	262	639	418	202	124	2
6	3	3	5	174	498	9	263	637	418	198	134	2
7	3	3	5	174	440	9	260	640	418	191	134	2
8	3	3	5	174	478	9	8	700	415	186	130	2
9	3	3	5	174	469	9	8	772	416	180	123	2
10	3	3	4	174	493	9	348	837	413	180	123	2
11	3	3	4	175	463	9	476	796	408	178	123	2
12	3	3	4	176	457	9	314	845	402	174	144	2
13	3	3	4	177	464	9	8	656	397	178	144	2
14	3	3	4	177	443	9	7	648	399	168	141	2
15	3	3	4	177	443	9	7	641	399	163	138	2
16	3	3	4	177	438	9	7	634	393	156	123	2
17	3	5	4	177	438	9	7	646	286	150	124	2
18	3	5	4	176	438	9	7	657	279	152	124	2
19	3	5	4	176	236	9	7	751	271	142	120	2
20	3	5	4	176	244	9	7	566	261	133	118	2
21	3	5	4	194	518	9	7	512	257	124	3	2
22	3	5	24	194	577	452	7	543	257	114	3	3
23	3	5	67	194	62	520	7	510	281	109	3	3
24	3	5	4	326	9	18	7	431	264	106	2	3
25	3	5	4	625	9	254	7	398	250	105	2	3
26	3	5	4	224	10	412	7	424	247	102	2	3
27	3	5	4	189	10	329	7	421	223	108	2	3
28	3	5	4	190	10	445	7	422	243	105	2	3
29	3	.....	4	190	10	50	7	417	244	103	2	2
30	3	.....	4	191	441	451	7	416	237	103	2	2
31	3	.....	4	.....	524	.....	7	417	.....	99	.....	2
1896.												
1	2	103	114	66	5	33	(a)	648	190	142	187	171
2	2	103	113	66	5	33	(a)	622	197	142	187	168
3	2	103	113	66	5	33	(a)	646	190	142	220	171
4	2	103	95	67	5	33	(a)	611	186	124	228	178
5	3	102	113	66	5	33	(a)	704	201	127	228	186
6	3	102	113	66	5	33	(a)	698	202	127	228	198
7	3	102	114	66	5	33	(a)	752	193	127	232	198
8	3	102	110	66	5	30	(a)	511	193	127	231	194
9	3	107	110	66	5	30	(a)	665	191	130	235	194
10	3	107	109	66	9	30	(a)	470	191	175	235	194
11	3	107	109	66	9	30	877	439	191	177	232	194
12	3	107	109	66	9	30	710	389	187	177	232	190
13	3	107	109	66	9	30	722	354	187	171	227	181
14	3	107	109	68	9	20	714	340	183	171	227	181
15	3	107	119	62	9	20	719	338	187	171	250	193
16	3	119	119	64	9	20	735	409	190	169	245	198
17	3	119	119	64	9	(a)	704	389	187	171	245	193
18	3	119	119	65	9	(a)	657	366	187	171	241	189
19	3	119	119	4	9	(a)	684	351	187	171	241	181
20	3	118	118	4	9	(a)	758	341	207	171	236	181

a Crevasse formed on June 17. Only part of water passed through dam. This continued into July.

Daily discharge, in second-feet, of Pine River below Pine River reservoir, Minn., for 1895–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1896.												
21	3	118	118	4	9	(a)	447	320	202	169	232	177
22	3	118	69	4	9	(a)	401	287	194	169	222	185
23	3	113	70	4	9	(a)	300	307	181	164	222	185
24	3	113	70	4	17	(a)	166	291	168	164	214	181
25	3	113	65	4	17	(a)	14	286	159	150	211	177
26	3	113	65	5	17	(a)	14	281	157	147	219	177
27	3	113	65	5	17	(a)	302	263	152	147	214	177
28	3	113	65	5	17	(a)	528	253	149	143	211	174
29	3	113	65	5	21	(a)	519	239	140	143	202	174
30	3	.....	65	5	21	(a)	541	229	137	180	190	170
31	57	.....	66	.....	21	(a)	649	220	.....	183	.....	170
1897.												
1	170	238	204	303	778	428	653	9	9	9	14	11
2	177	235	204	317	760	475	574	9	9	9	14	11
3	179	230	201	383	728	556	784	9	9	9	14	11
4	196	230	201	534	698	465	530	9	9	9	14	11
5	215	223	201	827	629	325	235	9	9	9	14	11
6	215	215	201	843	612	238	5	9	9	9	14	11
7	206	211	201	847	600	189	5	9	9	9	14	11
8	206	207	204	890	614	217	5	9	9	9	14	11
9	199	204	204	959	579	333	5	9	9	9	14	11
10	195	200	201	1,043	581	473	5	9	9	9	14	11
11	195	212	197	1,131	583	530	5	9	9	9	14	11
12	199	207	201	1,206	582	533	5	9	9	9	14	11
13	195	200	201	1,165	611	561	5	9	9	9	14	11
14	192	232	207	1,117	629	193	5	9	9	9	14	10
15	192	236	207	1,117	634	191	5	9	9	9	14	10
16	188	232	204	1,181	611	403	5	9	9	9	14	10
17	195	232	200	1,048	563	657	5	9	9	9	14	10
18	266	228	220	1,010	5	715	6	9	9	9	14	10
19	447	228	234	971	5	652	6	9	9	9	14	10
20	430	225	256	905	5	733	6	9	9	9	14	10
21	401	221	270	854	5	549	6	9	9	9	14	10
22	357	217	270	817	5	492	6	9	337	9	14	10
23	328	217	266	786	5	724	6	9	767	9	11	10
24	308	217	266	757	5	705	6	9	622	11	11	10
25	288	213	259	751	832	690	6	9	610	11	11	10
26	262	209	255	741	844	636	6	9	506	11	11	10
27	247	204	259	725	490	667	6	9	35	11	11	10
28	240	204	260	753	387	635	6	9	9	11	11	10
29	239	.....	264	743	327	621	6	9	9	11	11	13
30	234	.....	280	737	465	755	6	9	9	11	11	13
31	234	.....	290	.....	377	.....	6	9	.....	11	.....	13
1898.												
1	13	14	18	19	19	19	27	145	930	740	415	3
2	13	14	18	19	19	19	27	146	913	793	396	3
3	13	14	18	19	19	193	27	146	896	774	349	3
4	13	14	18	19	19	852	96	146	880	763	340	3
5	13	14	18	19	19	988	197	145	864	764	332	3
6	13	14	18	19	19	1,398	981	146	849	750	315	4
7	13	14	18	19	19	1,475	932	400	836	745	302	4
8	13	14	18	19	19	1,479	1,292	426	821	719	324	4
9	13	17	18	19	19	1,479	1,379	134	804	703	315	4
10	13	17	18	19	19	1,478	1,054	437	789	685	308	4
11	13	17	18	19	19	331	895	647	775	661	295	4
12	13	17	18	19	19	30	714	728	761	703	289	4
13	13	17	18	19	19	30	624	618	749	509	280	4
14	13	17	18	19	19	30	723	714	740	657	277	4
15	13	17	19	19	19	30	729	777	731	666	263	4
16	13	17	19	19	19	30	419	802	721	622	261	4
17	13	17	19	19	19	30	419	791	708	557	258	4
18	14	17	19	19	19	27	418	809	699	572	253	4
19	14	17	19	19	19	27	421	795	734	582	221	4
20	14	17	19	19	19	27	595	787	772	568	217	4
21	14	17	19	19	19	27	320	840	754	552	161	4
22	14	17	19	19	19	27	320	1,085	770	531	3	4
23	14	18	19	19	19	27	458	1,064	784	509	3	4
24	14	18	19	19	19	27	1,099	1,056	776	493	3	6
25	14	18	19	19	19	27	895	1,043	773	449	3	6

a Crevasse formed on June 17. Only part of water passed through dam. This continued into July.

Daily discharge, in second-feet, of Pine River below Pine River reservoir, Minn., for 1895–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1898.												
26	14	18	19	19	19	27	854	1,022	757	433	3	6
27	14	18	19	19	19	27	361	1,001	754	416	3	6
28	14	18	19	19	19	27	356	988	745	406	3	6
29	14	.....	19	19	19	27	353	972	778	442	3	6
30	14	.....	19	19	19	27	263	957	758	435	3	6
31	14	.....	19	.....	19	.....	145	944	.....	425	.....	6
1899.												
1	6	9	13	16	19	19	306	651	38	60	268	48
2	6	9	13	16	19	19	579	840	193	60	270	87
3	6	11	13	16	19	19	578	826	192	55	270	208
4	6	11	13	16	19	19	581	709	193	55	270	206
5	6	11	13	16	19	19	581	529	192	55	270	206
6	6	11	13	16	19	19	579	40	192	55	270	173
7	6	11	13	16	19	19	295	40	574	119	310	48
8	6	11	13	16	19	19	73	40	614	208	310	48
9	6	11	13	16	19	19	568	40	546	208	310	75
10	6	11	13	16	19	19	565	366	288	208	190	156
11	6	11	16	18	19	19	449	561	288	208	48	156
12	9	11	16	18	19	19	30	580	208	363	48	156
13	9	11	16	18	19	19	30	622	69	363	48	154
14	9	11	16	18	19	19	30	614	38	363	48	101
15	9	11	16	18	19	19	54	369	38	363	48	48
16	9	11	16	18	19	19	620	35	38	1,171	113	48
17	9	11	16	18	19	19	646	159	144	1,168	490	48
18	9	11	16	18	19	19	641	625	270	1,167	668	48
19	9	11	16	18	19	19	457	632	270	1,164	666	48
20	9	11	16	18	19	19	436	639	270	965	503	48
21	9	13	16	18	19	19	375	777	296	359	310	48
22	9	13	16	18	19	19	40	905	415	495	182	48
23	9	13	16	18	19	19	35	918	415	629	48	93
24	9	13	16	18	19	19	35	863	415	629	48	156
25	9	13	16	19	19	19	498	688	313	629	48	156
26	9	13	16	19	19	19	581	366	208	627	48	156
27	9	13	16	19	19	19	576	35	208	627	48	156
28	9	13	16	19	19	348	570	35	130	627	48	156
29	9	.....	16	19	19	425	561	35	60	627	48	156
30	9	.....	16	19	19	30	546	30	60	625	48	156
31	9	.....	16	.....	19	.....	537	30	.....	625	.....	156
1900.												
1	156	52	41	41	39	589	531	764	429	601	406	52
2	154	52	41	41	199	52	381	747	432	444	406	52
3	154	52	41	41	579	52	52	730	433	65	406	52
4	154	52	41	41	578	52	52	717	428	65	406	52
5	154	52	41	41	576	52	795	718	425	55	406	52
6	112	52	41	104	575	52	794	742	423	55	406	52
7	52	52	41	206	576	52	860	487	420	55	406	52
8	52	52	41	206	575	52	943	489	709	55	405	52
9	52	52	41	309	575	52	913	496	704	307	405	52
10	52	52	41	313	575	52	891	514	706	561	403	52
11	52	52	41	414	735	52	877	526	706	561	403	52
12	52	52	41	414	611	52	870	528	690	559	403	52
13	52	52	41	414	608	510	870	531	688	558	271	52
14	52	52	41	414	769	727	861	533	675	558	52	52
15	52	52	41	328	602	52	850	533	691	284	52	52
16	52	52	41	208	445	52	842	531	730	285	52	52
17	52	52	41	132	284	52	830	457	727	285	52	52
18	52	52	41	42	282	52	813	462	723	285	52	52
19	52	52	41	42	321	273	807	467	792	285	52	52
20	52	41	41	42	735	631	795	474	869	285	52	52
21	52	41	41	42	654	628	783	481	985	285	52	52
22	52	41	41	42	172	627	781	422	1,109	285	52	52
23	52	41	41	42	52	622	777	488	902	286	52	52
24	52	41	41	42	52	890	769	492	718	286	52	52
25	52	41	41	42	52	911	759	518	674	285	52	52
26	52	41	41	42	52	963	742	520	615	406	52	52
27	52	41	41	42	52	1,011	804	526	613	406	52	52
28	52	41	41	42	52	773	795	778	611	406	52	52
29	52	.....	41	42	52	553	791	769	606	406	52	52
30	52	.....	41	42	377	541	785	770	605	406	52	52
31	52	.....	41	.....	783	.....	777	565	.....	406	.....	52

Daily discharge, in second-feet, of Pine River below Pine River reservoir, Minn., for 1895–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1901.												
1	52	56	56	56	53	460	1,280	56	397	738	452	241
2	52	56	56	56	53	78	1,239	56	498	669	435	240
3	52	56	56	56	53	78	1,002	53	520	802	419	240
4	52	56	56	56	53	72	1,045	53	507	796	418	238
5	52	56	56	56	53	72	1,230	53	493	789	383	238
6	52	56	56	56	53	65	1,222	53	533	774	372	235
7	52	56	56	56	53	65	1,216	519	481	831	361	236
8	52	56	56	56	53	65	1,271	873	573	814	356	238
9	52	56	56	56	53	65	1,271	862	667	856	347	237
10	52	56	56	56	53	65	1,262	853	793	897	339	232
11	52	56	56	56	53	512	1,249	778	852	928	327	227
12	52	56	56	56	53	544	1,239	425	657	924	321	217
13	52	56	56	56	53	576	1,037	422	647	896	327	211
14	52	56	56	56	53	610	1,033	421	635	925	327	207
15	52	56	56	56	53	70	541	427	625	933	313	202
16	52	56	56	56	53	72	714	421	619	956	307	201
17	52	56	56	56	53	628	767	420	608	910	297	200
18	52	56	56	56	53	896	803	421	601	844	294	199
19	52	56	56	56	53	931	784	421	579	820	112	196
20	52	56	56	56	53	932	495	420	651	790	301	195
21	52	56	56	56	53	952	604	418	821	893	277	197
22	52	56	56	56	53	1,054	477	418	871	838	272	184
23	52	56	56	53	53	1,167	579	416	844	816	272	189
24	52	56	56	53	53	1,245	451	414	824	781	266	192
25	52	56	56	53	379	1,346	453	413	814	711	265	192
26	52	56	56	53	657	1,342	446	411	808	662	264	198
27	52	56	56	53	653	1,337	73	408	794	619	258	199
28	52	56	56	53	647	1,357	73	406	780	573	252	203
29	56	.....	56	53	650	1,586	396	404	765	535	247	201
30	56	.....	56	53	371	1,293	498	402	744	505	242	197
31	56	.....	56	.....	372	.....	277	399	.....	476	.....	192
1902.												
1	188	181	183	36	43	57	61	568	334	319	296	295
2	185	181	183	36	43	57	61	553	334	318	295	295
3	189	181	184	36	36	537	61	541	333	318	295	293
4	179	181	184	36	36	536	62	510	333	319	296	293
5	181	180	186	36	36	525	62	501	332	318	297	292
6	180	180	186	37	148	516	62	491	323	317	297	308
7	179	180	184	37	148	525	63	464	322	316	298	308
8	178	180	184	37	148	286	63	468	322	314	300	306
9	176	182	185	37	38	57	206	533	322	313	300	306
10	175	182	186	37	38	58	345	537	322	312	300	305
11	177	182	187	37	38	312	334	537	322	331	301	305
12	179	181	189	37	38	565	195	531	321	330	301	304
13	179	179	189	38	38	574	175	531	323	328	302	297
14	180	179	192	38	39	317	61	526	323	327	305	295
15	182	177	190	38	39	583	61	526	323	326	305	291
16	182	179	191	38	39	574	61	500	321	325	305	291
17	179	179	193	38	50	768	61	492	321	322	305	291
18	184	180	193	38	50	760	61	273	320	314	305	291
19	186	179	195	36	51	759	61	273	318	312	305	291
20	186	179	195	36	51	749	61	274	332	311	305	297
21	186	179	20	36	57	58	284	273	329	309	305	296
22	186	179	21	36	61	59	489	274	328	307	306	296
23	184	179	22	36	61	59	488	326	328	306	306	295
24	184	179	27	36	62	59	478	326	328	306	306	295
25	186	178	32	36	62	59	470	326	327	308	305	294
26	186	180	33	43	64	59	657	325	325	307	305	294
27	186	180	34	43	64	60	648	325	319	308	305	295
28	184	183	35	43	64	60	628	323	319	308	305	294
29	184	.....	36	43	65	61	628	322	318	308	297	294
30	183	.....	36	43	65	61	616	332	319	308	297	294
31	183	.....	36	.....	56	.....	606	332	.....	308	.....	294
1903.												
1	293	239	211	21	45	289	528	643	92	516	110	106
2	290	238	211	22	39	41	526	639	92	516	110	106
3	298	238	211	23	41	41	528	583	92	103	110	106
4	298	236	212	39	41	41	522	35	93	105	110	106
5	297	235	213	41	41	41	514	36	95	106	110	110

Daily discharge, in second-feet, of Pine River below Pine River reservoir, Minn., for 1895–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.												
6	296	234	214	42	41	42	504	36	95	107	110	110
7	295	231	223	43	42	42	497	36	96	109	109	110
8	295	230	224	44	42	43	292	89	96	110	109	110
9	294	227	225	45	40	43	713	89	97	111	109	110
10	287	224	226	47	40	43	706	89	98	105	109	110
11	285	222	227	39	40	43	695	89	99	106	109	110
12	283	217	229	41	41	43	684	89	89	107	110	106
13	283	211	231	43	41	43	449	90	91	107	110	106
14	283	230	229	46	41	331	438	90	92	108	110	106
15	281	224	227	48	43	607	234	91	92	108	110	106
16	279	223	228	49	39	602	36	91	93	109	110	106
17	285	223	229	49	40	592	37	91	94	111	110	106
18	281	221	231	40	40	587	37	91	95	111	110	106
19	284	221	232	40	287	312	37	91	88	112	110	106
20	284	221	235	40	527	274	37	91	89	112	110	106
21	283	219	237	41	523	497	37	91	89	113	107	106
22	280	221	237	41	278	493	461	92	89	113	107	106
23	278	221	238	41	40	485	37	92	89	113	107	106
24	244	222	238	42	41	478	37	92	89	107	107	106
25	229	222	239	41	41	470	37	92	89	107	107	106
26	228	222	241	42	302	563	37	93	89	107	107	106
27	227	222	242	43	556	558	38	93	89	107	107	106
28	226	214	244	43	553	553	38	94	89	108	105	106
29	225	.....	244	44	553	543	527	92	90	108	106	106
30	224	.....	244	44	548	536	619	92	90	108	106	106
31	239	.....	245	.....	543	.....	604	92	.....	109	.....	106
1904.												
1	106	263	416	420	483	121	127	159	354	503	284	302
2	104	306	416	420	483	121	594	159	359	500	286	291
3	104	345	416	420	483	128	581	158	361	498	286	291
4	104	374	422	414	483	129	572	158	359	498	296	289
5	104	400	422	413	483	130	565	153	359	497	296	289
6	104	395	421	413	490	130	561	153	357	848	296	289
7	104	391	407	413	491	337	124	153	361	841	296	289
8	105	306	407	449	491	596	124	153	223	838	296	289
9	104	108	406	481	491	595	124	152	139	838	296	283
10	104	108	406	486	264	592	126	152	139	839	296	283
11	104	108	407	496	108	588	578	195	139	839	290	283
12	104	108	406	496	108	545	572	356	139	836	288	281
13	104	111	406	496	168	610	561	470	139	833	288	281
14	104	111	409	496	167	603	554	531	139	831	288	281
15	104	111	409	501	167	597	554	529	139	813	288	281
16	106	111	407	502	166	591	554	529	141	811	288	279
17	106	111	407	502	167	583	553	529	530	810	288	279
18	106	111	399	491	168	576	558	528	529	807	298	279
19	106	111	399	491	168	567	556	523	527	806	298	279
20	106	113	397	491	115	559	549	523	525	804	298	277
21	106	113	414	491	115	123	674	523	522	803	298	277
22	106	152	431	483	115	123	778	523	520	800	298	277
23	107	191	430	483	116	123	731	689	527	815	298	272
24	107	191	430	483	116	124	727	685	525	589	296	272
25	107	254	427	498	116	125	119	455	525	587	304	272
26	107	315	427	498	117	126	120	510	506	596	304	272
27	107	367	427	498	120	126	120	306	506	595	304	272
28	116	418	428	498	120	127	120	304	504	593	304	272
29	154	416	428	485	120	127	159	354	504	410	304	272
30	186	.....	426	485	120	127	159	354	504	228	302	267
31	217	.....	426	.....	120	.....	159	354	.....	284	.....	267
1905.												
1	267	253	245	649	70	700	900	1,400	1,080	445	385	230
2	267	253	245	649	65	680	900	1,400	1,046	425	380	291
3	267	251	244	655	65	675	900	1,350	1,046	420	380	290
4	267	248	244	655	70	681	910	1,350	1,040	415	362	290
5	267	248	244	653	70	680	950	1,315	1,040	410	360	295
6	271	248	244	675	65	680	1,000	1,315	1,020	450	355	300
7	271	248	244	673	75	670	1,220	1,300	1,000	470	355	305
8	271	247	244	670	80	675	1,220	1,300	779	470	345	465
9	271	247	244	668	70	680	1,220	1,300	775	465	340	470
10	271	245	241	666	65	673	1,250	1,250	770	460	340	470

Daily discharge, in second-feet, of Pine River below Pine River reservoir, Minn., for 1895–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
11	271	245	241	662	60	670	1,250	1,152	770	450	329	470
12	271	245	241	658	50	660	1,250	1,300	760	440	325	460
13	263	245	241	667	50	660	1,250	1,402	750	430	320	450
14	261	245	241	660	50	600	1,405	1,400	725	345	315	430
15	261	245	241	654	50	600	1,400	1,200	612	340	310	410
16	261	245	241	646	60	600	1,400	1,100	612	340	310	400
17	261	241	238	640	70	700	1,400	1,050	600	345	310	390
18	261	241	462	634	85	700	1,400	1,350	578	340	299	380
19	261	241	458	350	660	700	1,400	1,227	600	330	295	370
20	257	241	579	94	700	700	1,400	1,227	575	320	290	360
21	257	241	576	61	738	720	1,375	1,227	570	388	285	350
22	257	241	572	63	740	720	1,375	1,350	564	375	280	352
23	257	241	650	65	740	720	1,375	1,248	564	370	275	350
24	257	245	646	66	735	790	1,375	1,248	564	365	270	340
25	257	245	643	67	740	790	1,400	1,200	560	365	239	330
26	257	245	638	67	700	790	1,520	1,200	550	365	133	320
27	253	245	634	67	675	800	1,500	1,180	540	365	245	310
28	253	245	632	68	675	800	1,500	1,175	530	396	240	300
29	253	.....	631	68	670	800	1,492	1,150	520	390	235	324
30	253	.....	657	68	665	908	1,450	1,140	450	390	230	320
31	253	.....	652	.....	739	.....	1,400	1,100	.....	390	.....	316
1906.												
1	312	304	270	270	360	800	516	20	20	32	50	175
2	308	302	262	270	360	701	527	20	20	30	50	180
3	305	302	270	273	365	10	723	20	20	28	50	180
4	300	300	274	280	380	6	725	20	400	20	45	180
5	311	299	275	310	486	200	725	20	500	22	45	180
6	308	298	277	327	854	4	725	20	750	20	40	185
7	306	298	278	340	570	3	730	20	750	a 600	40	185
8	304	298	280	350	700	0	725	20	750	a 650	40	196
9	302	281	295	360	500	0	500	20	740	a 650	40	198
10	300	280	295	420	597	0	760	20	740	a 650	40	198
11	300	280	293	480	350	0	761	20	730	a 650	40	200
12	307	280	293	560	530	0	500	20	730	a 650	40	200
13	307	280	293	690	575	0	500	20	730	700	40	205
14	306	277	293	700	575	0	750	20	730	802	834	210
15	306	276	288	720	600	0	750	20	614	800	805	261
16	305	260	286	740	600	4	740	20	720	700	815	261
17	304	259	285	765	650	0	730	20	700	750	805	261
18	304	258	285	785	1,048	5	870	20	690	790	795	262
19	305	256	278	790	612	0	840	20	200	609	110	262
20	305	256	278	867	1,000	0	432	30	200	749	105	262
21	305	254	277	870	625	581	50	20	200	846	100	262
22	305	252	277	870	650	600	30	20	200	678	89	254
23	305	275	272	840	650	590	30	20	200	670	92	254
24	305	275	272	815	1,000	580	30	20	200	150	95	250
25	305	273	273	795	1,010	300	30	20	150	75	105	250
26	306	272	273	800	890	0	28	20	180	65	125	250
27	306	272	273	801	950	669	25	20	30	60	134	250
28	306	270	270	785	960	731	20	20	30	60	157	250
29	306	.....	268	760	960	700	20	20	35	55	165	252
30	306	.....	269	375	950	600	20	20	35	55	170	252
31	305	.....	269	.....	955	.....	20	20	.....	55	.....	250
1907.												
1	252	365	585	1,011	30	321	40	25	20	490	613	316
2	255	378	604	1,012	30	327	35	25	20	490	613	315
3	256	376	556	1,012	30	333	35	35	20	489	612	312
4	256	372	541	1,012	30	339	35	35	20	490	603	310
5	249	372	656	1,055	30	50	35	35	20	489	607	308
6	249	372	643	1,012	30	40	33	35	20	513	602	306
7	249	370	620	1,013	30	35	30	35	20	513	583	305
8	248	270	617	1,046	30	344	30	35	20	513	582	305
9	248	355	639	1,047	30	575	30	35	20	513	583	304
10	240	352	639	1,047	30	622	30	35	500	673	582	303
11	238	351	1,028	1,047	30	772	30	400	459	665	582	302
12	246	350	1,020	1,047	30	780	30	770	455	665	580	300
13	246	350	1,011	1,059	30	400	30	760	455	660	580	298
14	246	347	1,005	1,046	30	525	30	755	455	661	582	296
15	246	347	996	1,035	30	410	30	750	454	662	581	294

a Repairing gates, estimate probably too low.

Daily discharge, in second-feet, of Pine River below Pine River reservoir, Minn., for 1895–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
16	396	335	993	1,035	30	400	30	748	454	657	322	296
17	390	335	1,023	1,034	30	540	30	745	452	658	322	295
18	383	335	1,023	1,012	30	775	30	780	452	653	324	294
19	383	338	1,012	1,012	30	778	30	785	452	654	326	293
20	383	338	1,012	1,045	30	775	30	1,032	455	648	326	292
21	383	338	1,001	1,011	30	300	30	1,020	536	648	327	292
22	380	338	971	1,000	30	150	30	1,005	535	649	327	291
23	380	301	990	150	30	780	405	1,072	534	648	328	290
24	375	300	979	125	30	350	770	1,060	530	642	326	289
25	375	298	1,012	100	30	785	765	1,050	528	638	324	288
26	385	298	1,012	75	30	778	775	1,040	525	638	322	287
27	385	298	1,011	60	30	785	770	1,030	520	867	321	288
28	380	361	1,000	50	318	360	765	30	518	861	320	287
29	375	.....	1,000	50	465	50	760	20	515	861	319	289
30	370	.....	1,002	40	465	50	755	20	512	613	317	290
31	368	.....	1,000	.....	315	.....	35	20	.....	613	.....	292
1908.												
1	291	263	314	290	119	136	123	130	580	800	330	142
2	290	265	312	143	120	137	727	130	575	455	332	143
3	289	270	310	145	121	137	124	129	570	450	333	143
4	288	276	308	130	121	138	125	128	20	448	335	144
5	287	282	306	132	122	138	125	126	520	446	337	144
6	287	300	304	135	122	139	124	124	525	444	338	144
7	285	310	309	138	121	137	124	122	535	440	339	144
8	283	324	309	125	121	134	123	120	540	436	338	144
9	281	324	308	128	120	129	123	120	546	432	337	143
10	280	325	308	130	120	126	122	120	700	429	336	143
11	281	326	307	123	121	124	121	120	699	427	335	143
12	279	326	306	124	122	122	121	120	698	426	332	143
13	278	325	305	126	123	120	122	120	705	424	331	143
14	277	326	306	128	123	120	122	120	720	421	329	144
15	276	327	306	130	124	120	927	120	750	418	327	144
16	275	325	305	131	125	121	127	122	770	415	325	143
17	274	324	305	132	125	121	126	122	835	413	323	143
18	275	323	304	115	124	120	126	825	830	415	321	144
19	274	322	303	116	125	120	128	820	832	417	319	144
20	272	321	302	117	126	121	130	818	826	600	317	145
21	270	320	302	118	126	121	132	815	820	610	142	146
22	269	319	303	120	127	122	785	808	815	618	142	146
23	268	318	304	122	128	122	780	970	812	622	141	147
24	266	317	305	124	129	121	775	960	810	627	141	148
25	267	316	300	127	130	121	773	950	806	625	140	149
26	266	315	298	126	131	120	770	940	804	620	140	149
27	265	314	295	125	132	121	768	960	805	615	141	149
28	264	313	300	124	133	121	765	583	806	610	141	149
29	263	344	299	123	134	122	129	585	805	336	141	149
30	262	.....	298	121	135	122	128	588	803	332	142	149
31	263	.....	295	.....	136	.....	127	585	.....	328	.....	149
1909.												
1	149	147	245	406	210	219	120	72	76	528	131	134
2	148	148	247	404	212	220	118	73	75	527	131	134
3	150	147	248	402	214	221	115	74	74	526	130	135
4	152	147	249	405	215	222	115	75	73	524	130	134
5	154	148	250	409	216	223	114	76	75	522	131	136
6	156	148	316	412	217	223	114	77	77	520	130	138
7	158	148	315	415	218	224	115	78	80	518	131	190
8	210	149	314	418	219	225	114	78	475	516	132	192
9	214	149	313	421	221	224	113	79	480	514	133	194
10	214	150	312	424	224	224	113	79	485	516	134	196
11	213	150	311	424	226	225	115	80	490	518	134	198
12	213	151	310	423	228	225	118	80	495	520	135	198
13	212	152	308	423	230	226	120	81	500	522	136	198
14	212	154	310	424	232	665	124	82	510	524	135	199
15	211	156	312	423	233	700	126	82	115	526	135	199
16	210	158	314	422	230	725	128	82	110	540	134	199
17	209	160	316	422	224	960	532	83	514	538	133	200
18	208	248	422	423	221	855	530	83	513	536	132	200
19	148	249	424	424	218	815	528	83	520	130	131	200
20	147	250	426	425	215	731	526	83	541	124	132	201

Daily discharge, in second-feet, of Pine River below Pine River reservoir, Minn., for 1895–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
21	146	249	424	425	212	705	524	83	540	125	132	201
22	145	248	422	426	210	700	360	84	539	123	133	201
23	144	247	420	426	211	690	75	84	538	121	133	202
24	144	246	418	427	212	500	72	85	537	123	134	202
25	144	245	416	428	213	230	72	85	536	125	133	202
26	145	244	415	429	214	228	73	86	535	126	134	203
27	145	243	413	202	215	225	74	87	534	127	134	204
28	146	243	412	204	216	223	73	88	533	128	134	206
29	146	.....	410	206	217	224	73	88	532	130	135	208
30	147	.....	409	208	218	225	73	89	530	131	135	210
31	147	.....	408	.....	219	.....	73	88	.....	131	.....	212
1910.												
1	212	500	675	675	642	640	123	275	65	470	71	68
2	213	505	672	679	644	646	120	180	10	473	71	69
3	214	510	668	678	646	651	121	69	10	474	72	70
4	214	515	665	676	648	658	123	68	10	475	72	70
5	215	519	662	675	650	657	125	67	10	474	73	70
6	215	519	656	673	652	656	127	66	10	475	73	70
7	216	519	652	671	654	654	129	66	10	440	73	70
8	216	515	648	669	655	653	130	66	10	400	73	70
9	216	515	642	667	656	651	133	67	10	395	73	70
10	217	560	635	665	657	650	133	67	10	360	73	70
11	217	615	630	663	658	649	134	67	10	310	73	70
12	218	655	622	662	659	650	134	68	10	290	73	71
13	218	656	625	660	660	651	135	68	62	71	73	71
14	219	657	628	658	661	655	135	68	62	70	72	71
15	219	658	630	656	658	658	136	67	62	69	72	72
16	222	660	632	654	656	662	136	67	62	69	72	72
17	225	662	636	652	652	665	132	67	67	70	71	72
18	230	664	640	650	650	670	128	66	67	70	71	73
19	235	666	643	646	645	660	125	66	67	70	71	73
20	400	668	647	643	640	640	122	66	67	71	70	74
21	415	672	655	640	637	600	120	66	68	71	69	75
22	419	674	660	635	637	575	117	66	68	71	69	75
23	430	676	675	632	637	525	115	66	68	71	68	76
24	450	678	682	633	637	450	118	67	68	71	68	77
25	460	680	688	634	636	426	120	67	69	71	67	77
26	470	681	693	634	637	420	125	67	70	71	67	78
27	480	680	690	635	636	430	300	67	160	71	67	77
28	490	678	685	636	636	426	287	67	590	71	68	78
29	493	.....	680	638	635	125	285	66	688	71	68	77
30	495	.....	675	640	636	125	283	66	630	71	67	78
31	498	.....	670	.....	637	.....	283	66	.....	71	.....	78

Monthly discharge of Pine River below Pine River reservoir, Minn., for 1895–1910.

[Drainage area, 452 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in millions of cubic feet.
1895.						
January	3	3	3.0	0.0066	0.008	8.03
February	5	3	3.9	.0086	.009	9.43
March	67	4	7.0	.015	.02	18.7
April	625	5	178	.394	.44	462
May	577	9	357	.789	.91	956
June	536	9	167	.369	.41	433
July	477	7	108	.239	.28	289
August	837	7	548	1.21	1.38	1,468
September	426	223	339	.749	.84	878
October	229	99	154	.341	.39	412
November	144	2	83	.184	.21	215
December	3	2	2.2	.0048	.006	5.89
The year	837	2	162	.359	4.90	5,160

Monthly discharge of Pine River below Pine River reservoir, Minn., for 1895–1910—Con.

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in millions of cubic feet.
1896.						
January	57	2	4.6	0.010	0.01	12.3
February	119	102	110	.243	.26	276
March	119	65	97.9	.216	.25	262
April	68	4	41.2	.091	.10	107
May	21	5	10.3	.023	.03	27.6
June 1–17	33	20	29.4	.065	.41	43.2
July 11–31	877	14	558	1.23	.96	1,012
August	704	220	420	.930	1.07	1,125
September	207	137	182	.403	.45	472
October	183	127	156	.345	.40	418
November	250	187	224	.496	.55	581
December	198	168	183	.405	.47	490
The periods						4,830
1897.						
January	447	170	245	.542	.62	656
February	238	200	219	.485	.50	530
March	290	197	229	.507	.58	613
April	1,206	303	849	1.88	2.10	2,200
May	844	5	469	1.04	1.20	1,260
June	755	191	511	1.13	1.26	1,320
July	784	5	94.1	.208	.24	252
August	9	9	9.0	.020	.02	24.1
September	767	9	103	.228	.03	267
October	11	9	9.5	.021	.02	25.4
November	14	11	13.2	.029	.03	34.2
December	13	10	10.7	.024	.03	28.6
The year	1,206	5	230	.509	6.63	7,210
1898.						
January	14	13	13.5	.030	.03	36.2
February	18	14	16.4	.036	.04	39.7
March	19	18	18.6	.041	.05	49.8
April	19	19	19.0	.042	.05	49.2
May	19	19	19.0	.042	.05	50.9
June	1,479	19	341	.754	.84	884
July	1,379	27	561	1.24	1.43	1,500
August	1,085	134	668	1.48	1.71	1,790
September	930	699	787	1.74	1.94	2,040
October	793	406	601	1.33	1.53	1,610
November	415	3	207	.458	.51	537
December	6	3	4.4	.097	.11	11.8
The year	1,479	3	271	.600	8.29	8,600
1899.						
January	9	6	7.9	.017	.02	21.2
February	13	9	11.4	.025	.03	27.6
March	16	13	15.0	.033	.04	40.2
April	19	16	17.5	.039	.04	45.4
May	19	19	19.0	.042	.05	50.9
June	425	19	43.9	.097	.11	114
July	646	30	402	.889	1.02	1,080
August	918	30	439	.972	1.12	1,180
September	614	38	239	.529	.59	619
October	1,171	55	480	1.06	1.22	1,290
November	668	48	210	.465	.52	544
December	208	48	114	.252	.29	305
The year	1,171	6	167	.369	5.05	5,320
1900.						
January	156	52	70.5	.156	.18	189
February	52	41	48.4	.107	.11	117
March	41	41	41.0	.091	.10	110
April	414	41	140	.310	.35	363
May	769	39	406	.898	1.04	1,090
June	1,011	52	368	.814	.91	954
July	943	52	748	1.66	1.91	2,000
August	778	422	573	1.27	1.46	1,530
September	1,109	420	661	1.46	1.63	1,710
October	601	55	325	.719	.83	870
November	406	52	201	.445	.50	521
December	52	52	52	.115	.13	139
The year	1,109	39	303	.670	9.15	9,590

Monthly discharge of Pine River below Pine River reservoir, Minn., for 1895–1910—Con.

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in millions of cubic feet.
1901.						
January	56	52	52.4	0.116	0.13	140
February	56	56	56	.124	.13	135
March	56	56	56	.124	.14	150
April	56	53	55.2	.122	.14	142
May	657	53	161	.356	.41	431
June	1,586	65	651	1.44	1.61	1,690
July	1,280	73	807	1.79	2.06	2,160
August	873	53	404	.894	1.03	1,080
September	871	397	667	1.48	1.65	1,730
October	938	476	784	1.74	2.00	2,100
November	452	112	314	.695	.78	814
December	241	184	212	.469	.54	568
The year	1,586	52	352	.779	10.62	11,100
1902.						
January	189	175	182	.403	.46	487
February	183	178	180	.398	.41	435
March	195	20	132	.292	.34	353
April	43	36	37.8	.084	.09	98
May	148	36	59	.131	.15	158
June	768	57	32.4	.072	.08	84
July	657	61	263	.582	.67	704
August	568	273	423	.938	1.08	1,130
September	334	318	325	.719	.80	842
October	331	306	315	.697	.80	844
November	306	295	302	.668	.74	783
December	308	291	297	.657	.76	795
The year	768	20	212	.470	6.38	6,710
1903.						
January	298	224	273	.604	.70	731
February	239	211	225	.498	.52	544
March	245	211	230	.509	.59	616
April	49	21	40.8	.090	.10	106
May	556	39	178	.394	.45	477
June	607	41	309	.684	.76	801
July	713	36	338	.748	.86	905
August	643	35	135	.299	.34	362
September	99	88	92	.204	.23	238
October	516	103	135	.299	.34	362
November	110	105	109	.241	.27	283
December	110	106	107	.237	.27	287
The year	713	21	181	.399	5.43	5,710
1904.						
January	217	104	113	.250	.29	303
February	418	108	225	.498	.54	564
March	431	397	415	.918	1.06	1,110
April	502	413	473	1.05	1.17	1,230
May	491	108	240	.531	.61	643
June	610	121	332	.735	.82	861
July	778	119	418	.925	1.07	1,120
August	689	152	365	.808	.93	977
September	530	139	370	.819	.91	959
October	848	228	684	1.52	1.75	1,830
November	304	284	295	.653	.73	765
December	302	267	280	.620	.72	750
The year	848	104	351	.777	10.60	11,100
1905.						
January	271	253	262	.580	.67	702
February	253	241	245	.542	.56	593
March	657	238	405	.896	1.03	1,080
April	675	61	431	.954	1.06	1,120
May	740	50	334	.739	.85	894
June	908	600	707	1.56	1.74	1,830
July	1,520	900	1,280	2.83	3.26	3,430
August	1,402	1,050	1,260	2.79	3.22	3,370
September	1,080	450	720	1.59	1.77	1,870
October	470	320	396	.876	1.01	1,060
November	385	133	304	.673	.75	788
December	470	230	359	.794	.92	961
The year	1,520	50	558	1.24	16.84	17,700

Monthly discharge of Pine River below Pine River reservoir, Minn., for 1895–1910—Con.

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in millions of cubic feet.
1906.						
January	312	300	305	0.675	0.78	817
February	304	252	278	.615	.64	672
March	295	262	279	.617	.71	747
April	870	270	600	1.33	1.48	1,560
May	1,010	350	687	1.52	1.75	1,840
June	800	0	236	.522	.58	612
July	870	20	446	.987	1.14	1,190
August	30	20	20.3	.045	.05	54.4
September	750	20	400	.885	.99	1,040
October	846	20	409	.905	1.04	1,100
November	834	40	202	.447	.50	524
December	262	175	226	.500	.58	605
The year	1,010	0	341	.754	10.24	10,800
1907.						
January	396	238	317	.701	.81	849
February	378	298	344	.761	.79	832
March	1,028	585	877	1.94	2.24	2,350
April	1,059	40	777	1.72	1.92	2,010
May	465	30	76.6	.170	.20	205
June	798	35	451	1.00	1.12	1,170
July	775	30	209	.462	.53	560
August	1,072	20	491	1.09	1.26	1,310
September	536	20	349	.772	.86	905
October	867	489	627	1.39	1.60	1,680
November	613	317	458	1.01	1.13	1,190
December	316	287	298	.659	.76	798
The year	1,072	20	440	.973	13.22	13,900
1908.						
January	291	262	276	.611	.70	739
February	327	263	312	.690	.74	782
March	314	295	304	.673	.78	814
April	290	115	132	.292	.33	342
May	136	119	125	.277	.32	335
June	139	120	126	.279	.31	327
July	927	121	317	.701	.81	849
August	970	120	429	.949	1.09	1,150
September	835	20	695	1.54	1.72	1,800
October	800	328	487	1.08	1.24	1,300
November	339	140	268	.593	.66	695
December	149	142	145	.321	.37	388
The year	970	20	301	.667	9.07	9,520
1909.						
January	214	144	171	.378	.44	458
February	250	147	190	.420	.44	460
March	426	245	349	.772	.89	935
April	429	202	391	.865	.97	1,010
May	233	210	219	.484	.56	586
June	960	219	410	.907	1.01	1,060
July	532	72	179	.396	.46	479
August	89	72	81.5	.180	.21	218
September	541	73	388	.859	.96	1,010
October	540	121	358	.792	.91	959
November	136	130	133	.294	.33	345
December	212	134	188	.416	.48	503
The year	960	72	255	.564	7.66	8,020
1910.						
January	498	212	311	.688	.79	833
February	681	500	613	1.36	1.42	1,480
March	693	622	657	1.45	1.67	1,760
April	679	632	654	1.45	1.62	1,700
May	661	635	647	1.43	1.65	1,730
June	670	125	573	1.27	1.42	1,490
July	300	115	153	.338	.39	410
August	275	66	77.2	.171	.20	207
September	688	10	106	.235	.26	275
October	475	69	206	.456	.53	552
November	73	67	70.7	.156	.17	183
December	78	68	73	.162	.19	195
The year	693	10	345	.764	10.31	10,800

CROW WING RIVER.

GENERAL FEATURES OF AREA DRAINED.

The area drained by Crow Wing River lies a little northwest of the center of Minnesota and embraces part or all of Cass, Hubbard, Wadena, Becker, Ottertail, Douglas, and Todd counties. The source of Crow Wing River is found in the southern part of Hubbard County in a remarkable chain of a dozen lakes of considerable size, extending about 30 miles in a northeast-southwest direction. These lakes occupy a river-like valley with abrupt sides 20 to 40 feet high. From the outlet of the lakes the Crow Wing flows southward and after crossing the line into Wadena County receives the waters of Shell River which heads in Shell Lake in Becker County. Below Shell River the Crow Wing takes a general southerly though very winding course until it is joined by Leaf and Partridge rivers; it then turns and flows southeastward to its junction with the Mississippi on the boundary between Cass and Morrison counties. The length of the river from the outlet of the lakes to the mouth is 89 miles.

Its only important tributaries, aside from those mentioned, are Long Prairie River, which enters from the south, and Gull River, which enters from the north near its mouth.

For 20 miles below the lake outlet the river winds between low swampy banks about 175 feet apart. Farther down the height of the banks and the width of the river gradually increase. In its lower course the stream flows 400 feet wide between banks some 30 feet high.

The following drainage areas have been measured on the Crow Wing and its tributaries.

Drainage areas in Crow Wing River basin.

River.	Above—	Drainage area.
		Sq. miles.
Crow Wing	Shell River	242
Do	Nimrod	1,010
Do	Oyelen	1,160
Do	Motley	2,140
Do	Pillager	3,230
Do	Mouth	3,580
Shell	do	612
Fish Hook	do	215
Leaf	Wing River	328
Do	Mouth	755
Long Prairie River	do	975
Gull	Gull Lake outlet	238
Do	Mouth	312

Altitudes within the basin range from 1,200 to 1,500 feet above sea level, and the gently undulating surface lies no great distance above the streams.

The entire basin is covered with blue till, consisting chiefly of sand, gravel, and clay, resting on Cretaceous rocks in the northern part

and on the Archean and Cambrian granites, gneisses, slates, and quartzites in the southern. In some parts of the area are deposits of sand and gravel from which the clay has been removed and these deposits yield water to the many springs found along the ravines and valleys and on the banks of the lakes. Nowhere in the basin does rock outcrop.

The upper part of the basin is heavily forested; the lower part is less densely timbered with jack pine. Lumbering has been carried on for many years, but although much of the area has been cut over little of the land has been cleared. Crow Wing River is used extensively for driving logs, both to Motley and to points on the lower Mississippi.

Rainfall records in the basin, extending back to 1885, indicate a mean annual precipitation of 28 inches. Of this amount 3 inches occurs during the winter months in the form of snow which remains throughout the season. The streams are frozen over from December to March with ice 1 foot or more in thickness. During this time the natural flow is very uniform, being fed entirely from the ground water, and the streams are not subject to winter freshets. The minimum flow usually occurs during February.

The basin contains 100 lakes, nearly all in the 850 square miles above the mouth of Shell River, where they comprise 5 to 10 per cent of total area. Most of these lakes are too far up on the headwaters to be of value as storage reservoirs, as their tributary run-off is small. At the outlet of Crow Wing Lakes is a dam which raises the water level about 8 feet for the purpose of driving logs in the spring. The operation of this dam increases the inequality of flow of the river instead of tending to equalize it, as the water is stored during the winter months (the natural low-water period) for the purpose of increasing the spring and early summer flow. After the driving is finished the dam is not used for storage until the next fall or winter. At the outlet of Fish Hook Lake is a dam used to furnish power for Park Rapids, and at the outlet of Gull Lake the United States Government is building a dam which will add a sixth unit to the reservoir system on the headwaters of the Mississippi.

In order to determine the availability of Crow Wing River for power development a survey was made during 1909 from the outlet of Crow Wing Lakes to the mouth of the river. From the data collected on this survey sheets have been prepared showing a profile of the water surface, a plan of the river, and the contours along the river bank. The results of this survey have been published on separate sheets and may be had upon application to the district engineer, United States Geological Survey, Old Capitol Building, St. Paul, Minn. From this survey the table following of elevations and distances has been compiled.

Elevations and distances along Crow Wing River.

Place.	Distance above mouth.	Elevation above sea level.
	Miles.	*Feet.*
Mississippi River	0	1,148
Gull River	4	1,156
Pillager Bridge	11	1,177
	15	1,188
Long Prairie River	20	1,205
Motley Bridge	22	1,212
	27	1,221
Swan Creek	32	1,230
Red Crow Wing Bridge	37	1,238
Thomastown Bridge	41	1,243
Farnum Creek	49	1,253
Township line 135–136 N	54	1,261
Oyelen Bridge	57	1,276
Beaver Creek	61	1,300
Nimrod Bridge	65	1,317
Westers Rapids, foot	66	1,320
Westers Rapids, head	67	1,330
Carters Ford	72	1,346
Fivemile bend	78	1,352
Huntersville Bridge	82	1,356
Crow Wing dam, tail-water	89	1,362

None of the available horsepower on the river has been developed.

The natural storage of the many lakes is increased by areas of swamp scattered throughout the drainage basin. It is estimated from the reports of county officials that about 60,000 acres of land have been benefited by drainage.

CROW WING RIVER AT NIMROD, MINN.

This station, which was established April 15, 1910, is located at the steel highway bridge at Nimrod post office, sec. 32, T. 137 N., R. 33 W. It is about 12 miles east of Sebeka, the nearest railroad point.

The chain gage is attached to the bridge, and discharge measurements are made at that section.

The nearest tributaries are Cat River, which enters nearly a mile below Nimrod, and Willow Creek, which enters about a mile above. The drainage area above the station is 1,010 square miles.

The river is used for log driving, and a dam at the outlet of Lower Crow Wing Lake controls the water from that portion of the drainage area. Since the establishment of the station there has been no trouble from log jams.

Crow Wing River has considerable fall near the station and one mile above there is a fall of 12 feet known as Westers Rapids.

As the station has not been established sufficiently long to be completely rated, no estimates of flow have been made, and only the base data are given.

From November to March the river is frozen over and observations are discontinued.

On May 19, 1910, the gage datum was lowered 1.20 feet, and the previous readings have been corrected to the new datum.

Discharge measurements of Crow Wing River at Nimrod, Minn., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 19	G. A. Gray	142	370	5.08	498
July 14	Robert Follansbee	139	305	4.60	198
Oct. 11	C. R. Adams	142	353	4.96	468

Daily gage height, in feet, of Crow Wing River at Nimrod, Minn., in 1910.

[W. H. Wintermute, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		5.04	5.60	4.55	4.50	4.45	5.40	4.72
2		5.02	5.60	4.55	4.50	4.45	5.40	4.72
3		5.08	5.85	4.55	4.50	4.45	5.40	4.72
4		5.10	5.55	4.55	4.50	4.45	5.40	4.71
5		5.10	5.05	4.60	4.50	4.48	5.32	4.70
6		5.10	4.85	4.60	4.50	4.46	5.22	4.70
7		5.08	4.80	4.60	4.50	4.45	5.15	5.08
8		5.05	4.78	4.68	4.50	4.45	5.10	5.35
9		5.04	4.71	4.68	4.50	4.45	5.09	5.35
10		5.02	4.70	4.65	4.50	4.45	5.04	5.35
11		5.01	4.70	4.70	4.50	4.45	4.96	5.38
12		5.00	4.70	4.65	4.54	4.45	4.92	5.40
13		5.00	4.70	4.60	4.58	[a] 4.88	4.91	5.28
14		5.00	4.68	4.60	4.58	5.35	4.90	5.10
15	5.10	5.00	4.62	4.59	4.55	5.48	4.86	5.10
16	5.15	5.04	4.60	4.54	4.51	5.45	4.81	5.20
17	5.22	5.11	4.60	4.50	4.48	5.00	4.76	.....
18	5.31	5.12	4.60	4.50	4.45	4.50	4.72	.....
19	5.38	5.09	4.60	4.50	4.45	4.45	4.78	.....
20	5.40	5.10	4.59	4.50	4.44	4.45	4.80	.....
21	5.34	5.16	4.56	4.50	4.42	4.42	4.85	.....
22	5.30	[a] 5.19	4.54	4.50	4.46	4.35	4.88	.....
23	5.30	5.18	4.51	4.52	4.45	4.40	4.88	.....
24	5.30	5.38	4.50	4.55	4.42	4.40	4.86	.....
25	5.30	5.58	4.54	4.55	4.42	[a] 4.95	4.85	.....
26	5.26	5.75	4.52	4.55	4.42	5.40	4.84	.....
27	5.21	5.85	4.55	4.54	4.42	5.42	4.82	.....
28	5.16	5.88	4.55	4.52	4.42	5.42	4.80	.....
29	5.09	6.00	4.55	4.52	4.42	5.42	4.79	.....
30	5.06	5.68	4.55	4.50	4.42	5.40	4.76	.....
31	.....	5.60	.....	4.50	4.42	.....	4.75	.....

[a] Gates in logging dam opened.

NOTE.—Ice present from Nov. 7 to Dec. 31.

CROW WING RIVER AT PILLAGER, MINN.

This station, which is located at the highway bridge half a mile south of Pillager, in sec. 20, T. 133 N., R. 30 W., was established June 11, 1909, on account of the power available on Crow Wing River.

The nearest tributary, Pillager Creek, enters the river a short distance below the station.

There are no dams near the station, as the only one on the river is a logging dam at the outlet of Lower Crow Wing Lake.

From December to March the river is frozen over at the gage and discharge measurements are made through the ice to determine the winter discharge. The staff gage is located at the bridge from which

measurements are made. The datum of the gage has remained unchanged since the station was established.

Conditions at this station are favorable for good results, although the river bed may shift somewhat during high water and thus necessitate the use of more than one rating curve. The records should therefore be reliable.

Discharge measurements of Crow Wing River at Pillager, Minn., in 1909–1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 23	G. A. Gray	215	1,000	6.84	1,670
23	C. B. Gibson	215	1,000	6.82	1,660
Aug. 5	Follansbee and Emerson	215	865	6.33	1,260
Sept. 1	C. J. Emerson	215	837	6.61	1,320
10	G. A. Gray	211	716	6.05	904
Nov. 3	do	211	642	6.10	976
1910.					
Feb. 1	G. A. Gray	211	618	[a] 7.11	776
25	do	209	490	[b] 7.01	591
Mar. 25	do	218	1,360	8.05	2,890
May 18	do	215	908	6.30	1,170
June 25	C. R. Adams	211	548	5.15	398
Oct. 12	do	214	511	5.59	616
Dec. 22	do	.....	311	[c] 5.95	383

[a] Gage height to surface of water; thickness of ice, 1.3 feet.
[b] Gage height to surface of water; thickness of ice, 1.7 feet.
[c] Gage height to surface of water; thickness of ice, 1 foot.

Daily gage height, in feet, of Crow Wing River at Pillager, Minn., for 1910.

[Miss Augusta Sterling, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.92	7.11	.....	7.09	6.62	6.34	5.04	4.88	4.76	5.98	5.46	.....
2	.....	7.11	7.15	6.99	6.51	6.30	5.01	4.86	4.86	5.89	5.44	.....
3	.....	.....	.....	6.89	6.48	6.32	5.00	4.86	4.92	5.94	5.41	5.75
4	.....	.....	.....	7.00	6.42	6.42	.....	4.85	5.00	5.82	5.40	.....
5	6.9	7.1	7.12	7.12	6.39	6.44	.....	4.84	5.01	5.76	.....	.....
6	.....	.....	.....	7.02	6.36	6.35	5.08	4.85	5.00	5.70	.....	.....
7	.....	.....	.....	6.85	6.31	5.96	5.06	4.89	5.00	5.70	.....	5.85
8	6.9	.....	.....	6.79	6.26	5.88	5.18	4.88	4.95	5.71	.....	.....
9	.....	7.12	.....	6.71	6.20	5.79	5.22	4.88	4.89	5.69	5.66	.....
10	.....	.....	.....	6.64	6.18	5.72	5.21	4.85	4.91	5.56	.....	5.80
11	.....	.....	.....	6.55	6.14	5.69	5.21	4.84	4.90	5.52	.....	.....
12	.....	7.02	.....	6.49	6.09	5.65	5.20	4.79	4.90	5.52	.....	.....
13	6.95	.....	7.82	6.35	6.06	5.59	5.24	4.86	4.86	5.50	5.98	.....
14	.....	.....	8.25	6.32	6.04	5.54	5.30	4.86	4.86	5.50	5.95	5.90
15	6.95	.....	8.40	6.69	6.00	5.48	5.30	4.92	5.45	5.46	5.80	.....
16	.....	7.0	8.75	7.12	6.08	5.41	5.24	4.94	5.72	5.45	5.54	.....
17	.....	.....	9.02	7.55	6.20	5.39	5.15	4.94	5.84	5.39	5.69	5.90
18	.....	.....	9.18	7.75	6.29	5.32	5.08	4.89	5.84	5.40	5.70	.....
19	.....	6.95	9.34	7.96	6.29	5.30	5.01	4.82	5.31	5.50	5.70	.....
20	7.0	.....	8.90	8.14	6.22	5.29	5.00	4.80	5.01	5.54	5.81	.....
21	.....	.....	8.76	8.20	6.18	5.24	5.04	4.79	4.96	5.56	5.72	5.95
22	7.0	.....	8.41	8.10	6.06	5.20	4.99	4.79	4.91	5.60	5.70	.....
23	.....	7.0	8.25	7.95	6.08	5.19	4.99	4.81	4.92	5.59	5.84	.....
24	.....	.....	8.08	7.78	6.11	5.18	5.00	4.89	5.00	5.55	5.92	5.95
25	.....	7.01	7.88	7.64	6.19	5.16	5.00	4.88	5.02	5.58	5.98	.....
26	.....	7.05	7.74	7.42	6.28	5.15	4.98	4.86	5.22	5.55	5.99	.....
27	7.08	.....	7.58	7.19	6.44	5.14	4.96	4.84	5.85	5.51	5.95	.....
28	.....	.....	7.46	7.05	6.49	5.12	4.91	4.81	5.95	5.50	5.75	.....
29	7.10	.....	7.35	6.85	6.42	5.11	4.90	4.78	5.98	5.48	5.60	.....
30	.....	.....	7.30	6.68	6.42	5.09	4.89	4.92	5.99	5.49	5.50	.....
31	.....	.....	7.19	.....	6.42	.....	4.86	4.81	.....	5.49	.....	6.00

NOTE.—Ice from Jan. 1 to Mar. 12, varying in thickness from 0.8 to 1.3 feet; also during November and and December. Thickness of ice during December ranged from 0.55 to 1.7 feet.

Daily discharge, in second-feet, of Crow Wing River at Pillager, Minn., for 1909–10.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.[a]											
1						1,050	1,370	1,360	920	980	
2						1,040	1,290	1,320	920	980	
3						887	1,250	1,250	890	965	
4						770	1,200	1,230	862	965	
5						722	1,200	1,150	855	935	
6						699	1,160	1,130	827	928	
7						660	1,110	1,080	855	928	
8						628	1,200	1,030	876	905	
9						600	1,610	995	920	890	
0						611	1,650	972	1,020	890	
1					1,610	611	2,170	928	1,140	890	
2					1,380	600	2,810	890	1,170	890	
3					1,330	600	3,320	876	1,130	935	
4					1,290	600	3,580	876	1,120	1,070	
5					1,610	595	3,800	890	1,100	614	
6					1,760	622	3,960	890	1,080	698	
7					1,760	740	3,840	876	1,080	1,060	
8					1,700	600	3,540	827	1,050	1,200	
9					1,800	575	3,120	890	1,030	1,270	
0					1,760	710	2,620	958	1,030	1,200	
1					1,780	1,380	2,320	1,020	1,090	1,040	
2					1,700	2,260	2,100	1,280	1,150	1,220	
3					1,660	3,020	1,940	1,380	1,160	1,200	
4					1,640	2,900	1,980	1,330	1,120	1,190	
5					1,560	2,720	2,020	1,290	1,140	1,130	
6					1,430	2,670	1,920	1,270	1,120	1,160	
7					1,310	2,390	1,800	1,180	1,080	1,200	
8					1,260	2,040	1,700	1,130	1,030	1,350	
9					1,170	1,800	1,570	1,050	1,020	1,220	
0					1,110	1,580	1,480	972	1,000	1,140	
1						1,480	1,410		980		
1910.[b]											
1	[c] 776	600	1,830	1,390	1,150	351	291	253	876	548	
2		615	1,730	1,290	1,120	339	285	285	813	537	
3		615	1,640	1,270	1,140	335	285	305	848	520	
4		625	1,740	1,220	1,220	346	282	335	764	515	
5		625	1,860	1,190	1,230	356	278	339	724	500	
6		650	1,760	1,170	1,160	367	282	335	685	500	
7		700	1,600	1,130	862	359	295	335	685	500	
8		800	1,540	1,090	806	411	291	316	692	500	
9		1,000	1,470	1,040	744	429	291	295	679	500	
0		1,250	1,410	1,020	698	424	282	302	603	500	
1		1,500	1,330	995	679	424	278	298	581	500	
2		2,000	1,280	958	655	420	262	298	581	500	
3		2,620	1,160	935	620	438	285	285	570	500	
4		3,140	1,140	920	592	465	285	285	570	500	
5		3,320	1,450	890	559	465	305	542	548	500	
6		3,780	1,860	950	520	438	313	698	542	500	
7		4,140	2,320	1,040	510	398	313	778	510	500	
8		4,350	2,540	1,110	475	367	295	778	515	500	
9		4,580	2,790	1,110	465	339	272	470	570	500	
0		3,980	3,000	1,060	460	335	265	339	592	500	
1		3,790	3,080	1,020	438	351	262	320	603	500	
2		3,340	2,960	935	420	331	262	302	625	500	[c] 383
3		3,140	2,780	950	416	331	268	305	620	500	
4		2,930	2,580	972	411	335	295	335	598	500	
5	[c] 591	2,690	2,420	1,030	402	335	291	343	614	500	
6		2,530	2,170	1,100	398	328	285	429	598	500	
7		2,350	1,930	1,230	393	320	278	785	576	500	
8		2,220	1,790	1,280	384	302	268	855	570	500	
9		2,100	1,600	1,220	380	298	259	876	559	500	
0		2,040	1,440	1,220	371	295	305	883	564	500	
1		1,930		1,220		285	268		564		

[a] Daily discharge computed from two well-defined rating curves except that from Nov. 15–30, which was estimated on account of presence of ice.
[b] Daily discharge computed from a well-defined curve, except that for Mar. 1–12 and Nov. 1–30, which is estimated.
[c] Discharge measurement.

Monthly discharge of Crow Wing River at Pillager, Minn., for 1909–10.

[Drainage area, 3,230 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
January						
February						
March						
April						
May						
June 11–30	1,800	1,110	1,530	0.474	0.35	B.
July	3,020	575	1,230	.381	.44	B.
August	3,960	1,110	2,130	.659	.76	B.
September	1,380	827	1,080	.334	.37	A.
October	1,170	827	1,020	.316	.36	A.
November	1,350	614	1,040	.322	.36	B.
December			[1] 925	.286	.33	C.
1910.						
January			[a] 770	.238	.27	C.
February			[a] 670	.207	.22	C.
March	4,580	600	2,260	.700	.81	B.
April	3,080	1,140	1,940	.601	.67	B.
May	1,390	890	1,100	.341	.39	B.
June	1,230	371	656	.203	.23	A.
July	465	285	365	.113	.13	A.
August	313	259	283	.088	.10	A.
September	883	253	443	.137	.15	A.
October	876	510	627	.194	.22	A.
November	548	[a] 500	504	.156	.17	C.
December			[a] 440	.136	.16	D.
The year	4,580		838	.260	3.52	

[a] Estimated.

LONG PRAIRIE RIVER NEAR MOTLEY, MINN.

Long Prairie River rises in Lake Irene and flows through Lakes Miltona, Ida, Louise, Darling, L'Homme Dieu, and Carlos; thence east and north into Crow Wing River just east of Motley. Its chief tributaries are Belle and Fish Trap rivers, and Eagle, Calamas, and Turtle creeks.

The gaging station, which is located at the highway bridge 1 mile south of Motley, in sec. 19, T. 133 N., R. 31 W., and 2 miles above the mouth of the river, was established June 10, 1909, as a check, in connection with the records of the station on the Crow Wing at Motley, on the records of the Crow Wing at Pillager, a few miles below.

Owing to the fall of the Long Prairie no backwater from the Crow Wing is recorded at the gage except possibly for a few days in the spring, when the Crow Wing is ice gorged. There are no dams on the river to affect its flow at the gaging station.

Discharge measurements are made from the bridge except during low stages, when they are made by wading a short distance upstream.

The datum of the staff gage, which is located about 200 feet above the bridge on the left bank, has remained unchanged since the gage was installed.

Conditions at this station are favorable for good results and the records should be reliable.

From November to March the river is frozen over at the gage, and during that period observations are discontinued.

Discharge measurements of Long Prairie River near Motley, Minn., for 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 24	C. B. Gibson	110	268	5.88	439
Aug. 4[a]	Robert Follansbee	103	135	5.12	153
Sept. 1[a]	C. J. Emerson	102	131	5.16	128
11[a]	G. A. Gray	97	111	5.08	113
1910.					
Mar. 24	G. A. Gray	112	287	6.20	587
July 15[a]	Robert Follansbee	80	89.1	4.92	83.2

[a] Wading section.

Daily gage height, in feet, of Long Prairie River near Motley, Minn., for 1910.

[John Greene, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	5.75	5.54	5.25	4.80	4.76	4.90	4.98	4.90
2	.....	5.72	5.45	5.22	4.80	4.78	4.92	4.99	4.90
3	.....	5.70	5.49	5.22	4.78	4.79	4.95	4.98	4.90
4	.....	5.69	5.48	5.25	4.80	4.76	4.98	4.95	4.88
5	.....	5.70	5.45	5.29	4.80	4.78	4.95	4.94	4.90
6	.....	5.70	5.45	5.36	4.85	4.78	4.94	4.92	4.90
7	.....	5.70	5.42	5.39	4.84	4.79	4.94	4.92	4.86
8	.....	5.65	5.40	5.34	4.86	4.78	4.92	4.91	4.85
9	.....	5.61	5.38	5.32	4.85	4.75	4.90	4.91	4.92
0	.....	5.60	5.35	5.30	4.90	4.75	4.90	4.92	4.92
1	.....	5.55	5.31	5.28	4.92	4.75	4.88	4.90	4.90
2	.....	5.52	5.30	5.26	4.95	4.76	4.86	4.90	5.06
3	.....	5.50	5.30	5.22	4.95	4.80	4.85	4.90	4.89
4	.....	5.49	5.30	5.20	4.94	4.82	4.85	4.89	4.88
5	.....	5.64	5.29	5.18	4.92	4.88	4.85	4.90	4.88
6	.....	5.85	5.38	5.12	4.90	4.89	4.88	4.90	4.89
7	6.98	6.00	5.44	5.09	4.89	4.85	4.88	4.92	.....
8	7.40	6.09	5.49	5.04	4.86	4.86	4.89	4.92	.....
9	7.10	6.18	5.46	5.00	4.82	4.86	4.90	4.92	.....
0	6.50	6.25	5.42	5.00	4.82	4.85	4.86	4.95	.....
1	6.52	6.25	5.39	4.96	4.86	4.82	4.86	4.95	.....
2	6.50	6.24	5.35	4.95	4.85	4.82	4.90	4.96	.....
3	6.38	6.20	5.34	4.92	4.85	4.85	4.90	4.99	.....
4	6.18	6.15	5.32	4.96	4.82	4.85	4.90	4.98	.....
5	6.08	6.08	5.30	4.95	4.80	4.85	4.90	4.94	.....
6	5.99	5.89	5.31	4.91	4.80	4.85	5.00	4.94	.....
7	5.95	5.82	5.30	4.91	4.80	4.85	5.02	4.92	.....
8	5.89	5.71	5.28	4.90	4.80	4.84	5.05	4.90	.....
9	5.85	5.64	5.25	4.86	4.79	4.82	5.02	4.88	.....
0	5.81	5.60	5.24	4.85	4.78	4.90	5.00	4.92	.....
1	5.80	.....	5.25	.....	.....	4.89	.....	4.90	.....

NOTE.—Ice present from Jan. 1 to Mar. 16 and from Nov. 17 to Dec. 31.

Daily discharge, in second-feet, of Long Prairie River near Motley, Minn., for 1909–10.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1909.									
1	.....	.....	.....	.....	258	143	135	151	132
2	.....	.....	.....	.....	250	135	132	145	132
3	.....	.....	.....	.....	242	132	132	140	132
4	.....	.....	.....	.....	231	127	132	135	127
5	.....	.....	.....	.....	220	122	132	135	125
6	.....	.....	.....	.....	220	122	122	127	122
7	.....	.....	.....	.....	212	125	125	132	125
8	.....	.....	.....	.....	212	163	122	135	122
9	.....	.....	.....	.....	198	195	122	143	122
10	.....	.....	.....	572	192	192	122	163	127
11	.....	.....	.....	534	185	292	120	175	125
12	.....	.....	.....	463	181	395	117	178	122
13	.....	.....	.....	410	178	426	110	172	122
14	.....	.....	.....	385	172	395	113	163	163
15	.....	.....	.....	347	163	347	117	160	160
16	.....	.....	.....	347	163	301	122	148	205
17	.....	.....	.....	385	163	275	120	143	175
18	.....	.....	.....	385	154	242	117	140	181
19	.....	.....	.....	395	154	227	122	135	185
20	.....	.....	.....	436	172	209	125	154	235
21	.....	.....	.....	463	212	195	163	148	181
22	.....	.....	.....	479	275	185	205	148	163
23	.....	.....	.....	490	267	178	212	145	148
24	.....	.....	.....	416	216	185	212	143	140
25	.....	.....	.....	361	198	178	220	145	145
26	.....	.....	.....	332	181	175	212	143	154
27	.....	.....	.....	310	175	163	216	127	205
28	.....	.....	.....	296	160	154	195	127	216
29	.....	.....	.....	288	154	148	175	127	205
30	.....	.....	.....	271	148	145	163	132	178
31	.....	.....	.....	.....	148	135	.....	135	.....
1910.									
1	.....	361	267	163	64	59	80	95	80
2	.....	347	231	154	64	61	84	97	80
3	.....	337	246	154	61	63	90	95	80
4	.....	332	242	163	64	59	95	89	77
5	.....	337	231	175	64	61	90	88	80
6	.....	337	231	198	72	61	88	84	80
7	.....	337	220	209	70	63	88	84	74
8	.....	314	212	192	74	61	84	82	72
9	.....	296	205	185	72	58	80	82	84
10	.....	292	195	178	80	58	80	84	84
11	.....	271	181	172	84	58	77	80	80
12	.....	258	178	166	90	59	74	80	113
13	.....	250	178	154	90	64	72	80	78
14	.....	246	178	148	88	67	72	78	77
15	.....	310	175	143	84	77	72	80	77
16	.....	410	205	127	80	78	77	80	78
17	1,060	490	227	120	78	72	77	84	.....
18	1,330	640	246	108	74	74	78	84	.....
19	1,140	589	235	99	67	74	80	84	.....
20	770	628	220	99	67	72	74	89	.....
21	782	628	209	91	74	67	74	89	.....
22	770	622	195	90	72	67	80	91	.....
23	699	600	192	84	72	72	80	97	.....
24	589	572	185	91	67	72	80	95	.....
25	534	534	178	90	64	72	80	88	.....
26	485	431	181	82	64	72	99	88	.....
27	463	395	178	82	64	72	104	84	.....
28	431	342	172	80	64	70	110	80	.....
29	410	310	163	74	63	67	104	77	.....
30	390	292	160	72	61	80	99	84	.....
31	385	.....	163	.....	60	78	.....	80	.....

NOTE.—Daily discharge computed from a well-defined rating curve.

Monthly discharge of Long Prairie River near Motley, Minn., for 1909–10.

[Drainage area, 973 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
June 10–30	572	271	398	0.409	0.32	B.
July	275	148	195	.200	.23	B.
August	426	122	207	.213	.25	B.
September	220	110	148	.152	.17	A.
October	178	127	145	.149	.17	A.
November	235	122	156	.160	.18	B.
1910.						
Mar. 17–31	1,330	385	682	.701	.39	A.
April	640	246	404	.415	.46	A.
May	267	160	203	.209	.24	A.
June	209	72	131	.135	.15	A.
July	90	60	71.4	.073	.08	A.
August	80	58	67.4	.069	.08	A.
September	110	72	84.1	.086	.10	A.
October	97	77	85.5	.088	.10	A.
Nov. 1–16	113	72	80.9	.083	.05	A.

SAUK RIVER.

GENERAL FEATURES OF AREA DRAINED.

Sauk River drains an area comprising 821 square miles lying south of the basin of Crow Wing River and north of that of the Crow. The Sauk rises in Osakis Lake, in the southwestern part of Todd County, and flows southeastward to its junction with the Mississippi about 2 miles above St. Cloud. Its tributaries are not important.

In its upper course Sauk River flows through a number of small lakes, such as Gurney, Roberts, Little Sauk, Saul, and Horseshoe. In all there are about 75 lakes in the basin, comprising 1 per cent of the drainage area. Many of these lakes are small and have no visible outlet.

The surface of the basin is rolling and is in general 40 to 80 feet above the level of the Sauk. Altitudes range from 1,050 to 1,400 feet above sea level. The entire area is covered with blue till—a mixture of sand, gravel, and clay laid down during the glacial epoch—underlain by Cretaceous sandstones and shales or Archean granite and syenites. Rocks outcrop at a few places in the basin, notably near St. Cloud, where granite is quarried. The sands and gravels of the drift yield water to the springs that emerge along the stream and also to shallow wells.

For half its length the Sauk forms the dividing line between the prairie district and the region of original forest which lies north of the river as far south as Richmond. The country below Richmond was formerly included in the timbered belt, but the proportion of

forested area has been greatly reduced by clearing. By far the greater part of the drainage basin in now under cultivation.

Rainfall records maintained at various points in the basin and extending over 10 years indicate that the mean annual precipitation in the upper part of the area is 26 inches; the lower part lies in a small zone where the rainfall as determined at three points is about 23 inches. During the winter months the average precipitation (equal to $2\frac{1}{2}$ inches of rainfall) is in the form of snow which remains until spring. The streams in the basin are frozen over from December to March with ice 1 foot or more thick. During this time the natural flow is very uniform, slightly decreasing until midwinter, when it is lowest. As there are no thaws during the winter the source of supply is the ground water.

The basin contains no important reservoir sites, as the lakes are too small and too far upstream to be of value in regulating the flow of the river. During the low-water period the operation of the power plants has an effect on the flow of the river, holding a part of it back for some hours and then releasing it to augment the natural flow for the remainder of the day.

Water power is developed as follows:

Developed water powers in Sauk River basin.

Place.	Fall utilized.	Average horsepower.
	Feet.	
Sauk Center	11	150
Melrose	14	200
Cold Spring	8	100
Near Mouth	8	60

The following table of approximate elevations and distances has been compiled chiefly from the reports of the Minnesota Geological Survey:

Elevations and distances along Sauk River.

Place.	Distance above mouth.	Elevation above sea level.
	Miles.	*Feet.*
Mississippi River	0	992
Great Northern Ry	5	1,035
Sec. 6, T. 123 N., R. 31 W	37	1,100
Great Northern Ry	62	1,172
Melrose (Great Northern Ry.)	68	1,201
Sauk Center (Great Northern Ry.)	76	1,212
Sauk Lake outlet	79	1,220
Little Sauk Lake outlet	90	1,240
Osakis Lake outlet	104	1,310

SAUK RIVER NEAR ST. CLOUD, MINN.

This station, which is located at the highway bridge 3 miles west of St. Cloud in sec. 9, T. 124 N., R. 28 W., and about 2 miles above the mouth of the river, was established July 8, 1909, in connection with the general investigation of the water resources of Minnesota.

The nearest tributary enters Sauk River at Rockville, 10 miles or more above the station. The nearest dam is at the mouth of the river and is 9 feet high. Not only is the station above the influence of this dam, but the dam itself prevents backwater from Mississippi River reaching the station. The first dam above the station is at Cold Springs, 15 miles distant. The opening and shutting of the turbine gates at Cold Springs affect the flow at the gaging station during the low-water season.

Discharge measurements are made at the bridge section, where is located the chain gage. Gage heights are read twice a day, and the mean of the readings is taken as the mean for the day.

From December to March the river is frozen completely over in the vicinity of the gaging station and discharge measurements are made through the ice to develop an approximate winter rating.

On account of the daily fluctuations of the stage of the river due to control of flow by dams above the station, the mean daily gage height during the low-water season is subject to some error, and the records for that period can not be considered better than fair.

Discharge measurements of Sauk River near St. Cloud, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 8	G. A. Gray	94	176	.....	224
Aug. 3	Robert Follansbee	94	166	6.14	174
18	C. J. Emerson	94	171	6.27	217
Sept. 2	do	92	143	5.93	145
Oct. 19	G. A. Gray	87	108	5.74	88.9
1910.					
Jan. 6	G. A. Gray	80	120	[a] 7.00	108
Feb. 28	do	99	86.9	[b] 6.80	61.0
Mar. 27	do	102	274	7.20	612
June 24	C. R. Adams	93	147	5.97	131
Aug. 2	G. A. Gray	77	85.8	5.63	72.9
Dec. 21	C. R. Adams	.....	54.5	[c] 6.10	12.8

[a] Gage height to water surface; thickness of ice, 1.25 feet.
[b] Gage height to water surface; thickness of ice, 1.90 feet.
[c] Gage height to water surface; thickness of ice 1.3 feet.

Daily gage height, in feet, of Sauk River near St. Cloud, Minn., for 1910.

[Ida Waite, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.7	7.3	7.2	7.45	5.85	5.55	5.55	5.2	5.4	5.9	5.2	.....
2	.....	.....	.....	7.45	5.85	5.5	5.45	5.45	5.4	5.95	5.2	.....
3	.....	.....	.....	7.4	5.9	5.4	5.5	5.2	5.5	5.9	5.2	6.0
4	6.9	.....	.....	7.2	5.95	5.4	5.4	5.3	5.2	5.8	5.2	.....
5	.....	7.25	8.0	7.15	5.95	5.4	5.45	5.3	5.15	5.6	5.2	.....
6	7.0	.....	.....	6.9	5.95	5.55	5.35	5.3	5.15	5.6	5.2	.....
7	.....	.....	.....	6.55	6.05	6.05	5.2	5.25	5.15	5.6	5.25	.....
8	7.35	7.4	8.2	6.65	6.0	6.1	5.3	5.2	5.1	5.4	5.2	6.0
9	.....	.....	.....	6.4	6.0	6.0	5.35	5.2	5.75	5.3	5.2	.....
10	.....	.....	.....	6.35	6.0	6.05	5.65	5.25	5.8	5.3	5.4	.....
11	6.9	.....	.....	6.2	5.95	6.1	5.25	5.3	5.15	5.7	5.2	.....
12	.....	.....	8.5	6.25	5.95	5.95	5.1	5.55	5.2	5.7	5.2	.....
13	.....	.....	.....	6.3	5.9	5.45	5.1	5.6	5.3	5.72	5.4	.....
14	.....	.....	.....	6.4	5.9	5.3	5.1	5.6	5.3	5.7	5.4	.....
15	6.9	7.35	8.95	6.55	5.8	5.3	5.15	5.6	5.4	5.72	5.35	.....
16	.....	.....	.....	6.55	5.8	5.3	5.1	5.65	5.4	5.6	5.15	.....
17	.....	.....	.....	6.5	5.7	5.3	5.1	5.95	5.4	5.4	5.25	.....
18	6.95	.....	.....	6.5	5.45	5.3	5.1	5.6	5.5	5.3	5.3	6.0
19	.....	6 8	7.85	6.45	5.35	5.35	5.1	5.45	5.6	5.2	5.4	.....
20	.....	.....	7.65	6.4	5.35	5.3	.....	5.2	5.55	5.2	5.2	.....
21	.....	.....	7.55	6.45	5.45	5.35	5.4	5.2	5.6	5.2	5.15	6.1
22	6.7	6.7	7.4	6.45	5.35	5.4	5.1	5.25	5.45	5.2	5.5	.....
23	.....	.....	6.45	6.5	5.35	5.5	5.1	5.2	5.6	5.2	5.6	.....
24	.....	.....	6.3	6.6	5.45	5.5	5.1	5.35	5.6	5.2	5.6	.....
25	7.1	.....	6.75	6.55	5.45	5.5	5.15	5.25	5.35	5.4	5.5	6.0
26	.....	7.1	6.55	6.45	5.55	5.55	5.2	5.2	5.65	5.38	6.15	.....
27	.....	.....	6.85	.....	5.5	5.55	5.6	5.6	5.65	5.2	5.6	.....
28	.....	6.8	6.9	.....	5.6	5.55	5.7	5.4	5.6	5.35	.....	.....
29	.....	.....	7.0	.....	5.55	5.6	5.6	5.2	5.6	5.4	.....	6.1
30	.....	.....	7.2	.....	5.5	5.6	5.65	5.3	5.9	5.25	.....	.....
31	.....	.....	7.15	.....	5.55	.....	5.6	5.4	.....	5.3	.....	.....

NOTE.—Ice present from Jan. 1 to Mar. 15 and from Nov. 21 to Dec. 31.

Daily discharge, in second-feet, of Sauk River near St. Cloud, Minn., for 1909–10.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1	.....	.....	.....	.....	.....	.....	.....	154	109	101	71	.....
2	.....	.....	.....	.....	.....	.....	.....	166	99	93	85	.....
3	.....	.....	.....	.....	.....	.....	.....	166	99	85	95	.....
4	.....	.....	.....	.....	.....	.....	.....	250	95	71	98	.....
5	.....	.....	.....	.....	.....	.....	.....	161	95	71	93	.....
6	.....	.....	.....	.....	.....	.....	.....	78	51	78	103	.....
7	.....	.....	.....	.....	.....	.....	.....	110	70	85	99	.....
8	.....	.....	.....	.....	.....	.....	266	142	105	85	93	.....
9	.....	.....	.....	.....	.....	.....	400	220	77	85	161	.....
10	.....	.....	.....	.....	.....	.....	425	212	91	85	112	.....
11	.....	.....	.....	.....	.....	.....	400	226	63	88	118	.....
12	.....	.....	.....	.....	.....	.....	670	226	42	93	98	.....
13	.....	.....	.....	.....	.....	.....	400	206	42	101	101	.....
14	.....	.....	.....	.....	.....	.....	425	206	63	93	88	.....
15	.....	.....	.....	.....	.....	.....	555	135	63	95	85	.....
16	.....	.....	.....	.....	.....	.....	400	67	77	91	93	.....
17	.....	.....	.....	.....	.....	.....	400	78	91	66	120	.....
18	.....	.....	.....	.....	.....	.....	266	67	99	70	131	.....
19	.....	.....	.....	.....	.....	.....	317	74	109	63	179	.....
20	.....	.....	.....	.....	.....	.....	317	74	152	74	206	.....
21	.....	.....	.....	.....	.....	.....	500	74	77	85	220	.....
22	.....	.....	.....	.....	.....	.....	500	74	63	85	220	.....
23	.....	.....	.....	.....	.....	.....	378	70	77	82	214	.....
24	.....	.....	.....	.....	.....	.....	378	74	77	85	220	.....
25	.....	.....	.....	.....	.....	.....	317	176	91	85	192	.....
26	.....	.....	.....	.....	.....	.....	250	152	84	78	206	.....
27	.....	.....	.....	.....	.....	.....	250	63	79	82	220	.....
28	.....	.....	.....	.....	.....	.....	250	51	84	58	220	.....
29	.....	.....	.....	.....	.....	.....	220	51	84	78	220	.....
30	.....	.....	.....	.....	.....	.....	166	26	84	78	220	.....
31	.....	.....	.....	.....	.....	.....	154	63	.....	58	.....	.....

Daily discharge, in second-feet, of Sauk River near St. Cloud, Minn., for 1909–10—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910.												
1	.....	.....	90	762	110	64	64	30	47	120	30	.....
2	.....	.....	100	762	110	58	52	52	47	131	30	.....
3	.....	.....	115	730	120	47	58	30	58	120	30	.....
4	.....	.....	130	610	131	47	47	38	30	101	30	.....
5	.....	.....	150	582	131	47	52	38	27	71	30	.....
6	a 108	.....	190	450	131	64	42	38	27	71	30	.....
7	.....	.....	210	300	154	154	30	34	27	71	34	.....
8	.....	.....	250	336	142	166	38	30	24	47	30	.....
9	.....	.....	350	250	142	142	42	30	93	38	30	.....
10	.....	.....	450	235	142	154	78	34	101	38	47	.....
11	.....	.....	550	192	131	166	34	38	27	85	30	.....
12	.....	.....	600	206	131	131	24	64	30	85	30	.....
13	.....	.....	600	220	120	52	24	71	38	88	47	.....
14	.....	.....	650	250	120	38	24	71	38	85	47	.....
15	.....	.....	700	300	101	38	27	71	47	88	42	.....
16	.....	.....	700	300	101	38	24	78	47	71	27	.....
17	.....	.....	800	282	85	38	24	131	47	47	34	.....
18	.....	.....	850	282	52	38	24	71	58	38	38	.....
19	.....	.....	950	266	42	42	24	52	71	30	47	.....
20	.....	.....	990	250	42	38	36	30	64	30	30	.....
21	.....	.....	828	266	52	42	47	30	71	30	27	a 13
22	.....	.....	730	266	42	47	24	34	52	30	30	.....
23	.....	.....	266	282	42	58	24	30	71	30	30	.....
24	.....	.....	220	317	52	58	24	42	71	30	30	.....
25	.....	.....	378	300	52	58	27	34	42	47	30	.....
26	.....	.....	300	266	64	64	30	30	78	45	30	.....
27	.....	.....	425	235	58	64	71	71	78	30	30	.....
28	.....	a 61	450	204	71	64	85	47	71	42	30	.....
29	.....	.....	500	172	64	71	71	30	71	47	30	.....
30	.....	.....	610	141	58	71	78	38	120	34	30	.....
31	.....	.....	582	.....	64	.....	71	47	.....	38	.....	.....

a Discharge measurement.

NOTE.—Daily discharge computed from a well-defined rating curve, except that for Mar. 1–21 and Nov. 22–30, 1910, when the discharges are estimated, because of presence of ice.

Monthly discharge of Sauk River near St. Cloud, Minn., for 1909–10.

[Drainage area, 816 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
July 8–31	670	154	358	0.439	0.39	B.
August	250	26	126	.154	.18	B.
September	152	42	83.1	.102	.11	B.
October	101	58	81.5	.100	.12	B.
November	220	71	146	.179	.20	C.
December	.....	.....	a 100	.123	.14	C.
1910.						
January	.....	.....	a 100	.123	.14	C.
February	.....	.....	a 80.0	.098	.10	D.
March	990	90	475	.582	.67	C.
April	762	141	334	.409	.46	B.
May	154	42	92.2	.113	.13	B.
June	166	38	72.0	.088	.10	B.
July	85	24	42.6	.052	.06	B.
August	131	30	47.2	.058	.07	B.
September	120	24	55.8	.068	.08	B.
October	131	30	59.9	.073	.08	B.
November	47	30	33.0	.040	.04	B.
December	.....	.....	a 20.0	.025	.03	C.
The year	990	.....	118	.144	1.96	

a Estimated.

CROW RIVER.

GENERAL FEATURES OF AREA DRAINED.

The area drained by Crow River lies in Stevens, Kandiyohi, Meeker, Renville, McLeod, Wright, and Hennepin counties, between the basins of the Sauk and the Minnesota. Crow River proper is a short stream, being formed by the junction of the North and South Branches 2 or 3 miles above Rockford. Throughout its course it forms the boundary between Hennepin and Wright counties, and it discharges into the Mississippi at Dayton. The North Branch, which is the longer of the two, rises in McLeod and Grove lakes in the eastern part of Pope County. These lakes together are about 4 miles long and average one-third mile wide. From the outlet of the lakes the general course of the North Branch is southeastward through Rice and Cedar lakes, both of which are of considerable size. At Manannah it receives the Middle Branch, which rises in Crow Lake, in the southwestern part of Stevens County, and flows southward through Green Lake (area several square miles) and then eastward to its junction with the North Branch. Below the Middle Branch it receives one or two small tributaries which also head in lakes. The South Branch heads in a number of lakes in the southeastern part of Kandiyohi County, from which it takes a general easterly course, flowing through Otter Lake.

The following drainage areas have been measured in this basin:

Drainage areas in Crow River basin.

River.	Above—	Drainage area.
		Sq. miles.
North Branch	Cedar Lake	303
Do	Junction with South Branch	1,310
South Branch	Junction with North Branch	1,170
Crow	Rockford	2,520
Do	Mouth	2,590

The valley of the North Branch lies 40 to 50 feet below the general surface level; that of the South Branch is from 30 to 40 feet below the surface and one-fourth to one-half mile wide. The basin of the North Branch contains about 70 lakes, comprising approximately 3 per cent of its drainage area; that of the South Branch contains 120 lakes, comprising 2 per cent of the total area drained. Many of these lakes are small and have no apparent outlet. Altitudes range from 900 to 1,300 feet above sea level.

The entire basin is covered by blue till, of glacial origin, and scattered through it, especially in the western portion, are deposits of modified drift composed of sand and gravel. These deposits being porous form ground-water reservoirs which give rise to springs, though such springs are not of great importance in the Crow River basin. In the western part of the area the drift rests on Cretaceous

rocks; in the eastern part it is underlain by Archean granites and upper Cambrian sandstones. Rock outcrops are found nowhere in the basin.

The lower part of the area, east of the west line of Wright County, lies in the district that was originally forested; the upper part is in the prairie region. Very little of the area is forested at the present time. The land is nearly all under cultivation.

The mean annual rainfall in the northern part of the basin is about 23 inches; in the rest of the basin it is 27.5 inches. Of this amount about 3 inches occurs in the form of snow, which remains on the ground until spring. The rivers are frozen over during the winter and their flow is very uniform, decreasing gradually until midwinter, when it is at its minimum. There are no winter thaws to cause freshets.

The lakes in the basin are so small and have so little tributary run-off that they are of little value as reservoir sites.

Water power is developed at the following points in the basin:

Developed water power in Crow River basin.

Run.	Place.	Fall utilized.	Average horsepower.
		Feet.	
North Branch	Manannah		50
Do	Forest City		50
Do	Kingston		50
Do	French Lake		50
Middle Branch	Green Lake	7	75
Do	New London	12	100
South Branch	Hutchinson	8	60
Crow River	Rockford	7	20
Do	Hanover	7	60
Do	Bernings Mill	5.5	40

Considerable drainage work has been done in the flatter parts of the basin, with the result that more than 50,000 acres have been reclaimed, of which nearly 40,000 are in Kandiyohi County.

NORTH FORK OF CROW RIVER NEAR ROCKFORD, MINN.

This station, which is located 3 miles west of Rockford at the first highway bridge above the forks, 1½ miles distant, in sec. 23, T. 119 N., R. 25 W., was established June 15, 1909, because of the power available on the river and also to obtain records to check (in connection with the South Fork station) the records at Rockford on the main stream. The drainage area above this station is 1,310 square miles.

No tributaries enter the North Fork within several miles of the station. The nearest dam is that at Rockford, which backs the water up to a point beyond the gage.

The river is icebound from December to March, inclusive, and during that period observations are discontinued, but the minimum flow

can be roughly estimated by comparing drainage areas and records of the minimum run-off per square mile of drainage area at the Rockford station.

The datum of the staff gage, which is located at the bridge, has remained unchanged since the station was established; but from July 27 to August 10, 1909, when the dam at Rockford was open for repairs, the conditions of flow were temporarily changed.

Owing to the changeable conditions of flow, no estimate of daily discharge has been made, and only the base data are given. The station was discontinued June 30, 1910.

Discharge measurements of North Fork of Crow River near Rockford, Minn., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 17	C. J. Emerson	142	808	6.88	1,210
June 4	G. A. Gray	124	438	3.90	108

Daily gage height, in feet, of North Fork of Crow River near Rockford, Minn., for 1910.

[Miss Grace Wandersee, observer.]

Day.	Mar.	Apr.	May.	June.	Day.	Mar.	Apr.	May.	June.
1	.....	5.05	4.15	3.85	16	7.05	4.18	4.00	3.80
2	.....	4.95	4.15	3.89	17	6.85	4.30	4.02	3.78
3	.....	4.82	4.12	3.90	18	6.72	4.42	4.05	3.70
4	.....	4.70	4.10	3.86	19	6.58	4.45	4.05	3.70
5	.....	4.60	4.10	3.85	20	6.45	4.40	4.10	3.62
6	.....	4.60	4.10	3.85	21	6.25	4.40	4.10	3.55
7	.....	4.58	4.10	3.85	22	6.08	4.35	4.10	3.52
8	.....	4.50	4.10	3.82	23	5.95	4.30	4.08	3.60
9	.....	4.42	4.08	3.80	24	5.75	4.35	4.04	3.55
10	5.20	4.40	4.05	3.80	25	5.62	4.30	4.04	3.52
11	5.42	4.40	4.02	3.80	26	5.52	4.30	4.00	3.65
12	5.72	4.40	4.00	3.80	27	5.40	4.30	4.00	3.80
13	6.20	4.36	4.00	3.80	28	5.30	4.25	3.99	3.78
14	6.62	4.35	4.00	3.80	29	5.24	4.22	3.90	3.75
15	7.30	4.22	4.00	3.80	30	5.15	4.20	3.90	3.60
					31	5.05	.....	3.86	.....

CROW RIVER AT ROCKFORD, MINN.

This station, which is located at the highway bridge at Rockford, was established June 4, 1909, to determine the power available on Crow River.

A little more than a mile above the station is the junction of the North and South forks. Between the forks and the station two very small streams—the outlets of Rebecca Lake and Lake Sarah—enter the river. Stations were originally established on both branches above their junction to be used as a check on the Rockford records, but the conditions on the North Branch were so unsatisfactory that the station was discontinued June 30, 1910.

During high and medium stages discharge measurements are made from the bridge at which the staff gage is located; at low stages measurements are made from a boat and cable several hundred yards downstream.

About 400 feet above the station is the 7-foot dam of a flour mill, which operates intermittently. As the turbine has used but a small portion of the flow since the establishment of the station the effect of shutting it down is inappreciable at the gage except during extreme low water. At that time four readings per day are taken to determine the mean flow.

Owing to the proximity of the dam to the station the relation between gage height and discharge is not greatly affected by ice, the stream remaining open through the greater part of the section and for a distance of several hundred yards below. Winter measurements show that the open rating curve applies throughout the year.

The datum of the gage has remained unchanged since the station was established.

Conditions at this station are favorable for excellent results, and the records should be reliable.

Discharge measurements of Crow River at Rockford, Minn., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 26	G. A. Gray	273	181	5.27	245
Mar. 17	C. J. Emerson	285	1,250	9.33	2,990
July 14[a]	G. A. Gray	182	191	4.75	71.1

[a] Made at wading section.

Daily gage height, in feet, of Crow River at Rockford, Minn., for 1910.

[Geo. W. Florida, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.38	5.24	5.17	6.38	5.42	5.08	4.88	4.71	4.72	4.66	4.80	4.83
2	5.38	5.24	5.16	6.32	5.41	5.08	4.83	4.71	4.72	4.63	4.80	4.82
3	5.38	5.22	5.16	6.22	5.36	5.06	4.81	4.68	4.73	4.70	4.80	4.84
4	5.37	5.22	5.14	6.18	5.32	5.04	4.81	4.69	4.72	4.70	4.80	4.76
5	5.38	5.22	5.20	6.10	5.32	5.04	4.78	4.68	4.73	4.68	4.82	4.82
6	5.38	5.21	5.28	6.06	5.32	5.08	4.77	4.68	4.73	4.69	4.76	4.80
7	5.37	5.20	5.47	6.00	5.33	5.04	4.79	4.69	4.71	4.70	4.80	4.80
8	5.36	5.20	5.60	5.98	5.37	5.02	4.77	4.68	4.71	4.71	4.75	4.80
9	5.36	5.20	6.25	5.91	5.38	5.00	4.79	4.65	4.71	4.61	4.80	4.78
10	5.38	5.20	6.72	5.87	5.31	4.92	4.78	4.66	4.69	4.70	4.79	4.79
11	5.38	5.20	7.22	5.82	5.28	5.00	4.76	4.65	4.69	4.71	4.78	4.75
12	5.38	5.18	7.80	5.77	5.29	4.99	4.76	4.64	4.68	4.70	4.76	4.78
13	5.36	5.18	8.40	5.72	5.26	4.94	4.75	4.68	4.67	4.69	4.76	4.77
14	5.35	5.20	9.10	5.66	5.26	4.96	4.74	4.72	4.68	4.68	4.80	4.77
15	5.35	5.18	10.10	5.70	5.26	4.96	4.74	4.73	4.68	4.69	4.80	4.78
16	5.36	5.18	9.84	5.67	5.30	4.94	4.74	4.75	4.68	4.64	4.78	4.76
17	5.36	5.17	9.35	5.66	5.40	4.92	4.74	4.75	4.69	4.68	4.78	4.77
18	5.37	5.18	9.10	5.73	5.34	4.90	4.76	4.74	4.67	4.70	4.80	4.75
19	5.37	5.20	8.86	5.74	5.36	4.87	4.74	4.74	4.68	4.68	4.82	4.78
20	5.37	5.18	8.70	5.76	5.40	4.84	4.74	4.73	4.66	4.72	4.80	4.76
21	5.34	5.18	8.34	5.75	5.44	4.81	4.75	4.72	4.66	4.74	4.82	4.76
22	5.34	5.16	8.04	5.74	5.40	4.82	4.74	4.72	4.65	4.75	4.84	4.74
23	5.32	5.16	7.82	5.74	5.38	4.80	4.74	4.72	4.65	4.75	4.84	4.74
24	5.30	5.18	7.58	5.71	5.34	4.79	4.71	4.72	4.63	4.76	4.80	4.72
25	5.28	5.16	7.35	5.65	5.30	4.82	4.71	4.71	4.61	4.78	4.84	4.66
26	5.27	5.16	7.16	5.60	5.24	4.91	4.72	4.71	4.67	4.79	4.84	4.66
27	5.26	5.18	6.95	5.58	5.21	5.02	4.73	4.71	4.67	4.80	4.81	4.72
28	5.26	5.18	6.80	5.58	5.16	5.00	4.72	4.71	4.65	4.81	4.84	4.72
29	5.26	.....	6.68	5.52	5.13	4.97	4.73	4.71	4.65	4.81	4.84	4.72
30	5.26	.....	6.58	5.47	5.10	4.91	4.71	4.73	4.65	4.75	4.84	4.72
31	5.24	.....	6.46	.....	5.08	.....	4.71	4.73	.....	4.80	.....	4.72

NOTE.—Relation between gage height and discharge at this station not affected by ice.

Daily discharge, in second-feet, of Crow River at Rockford, Minn., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	291	233	206	833	309	172	107	64	67	54	85	93
2	291	233	202	797	304	172	93	64	67	49	85	90
3	291	225	202	737	283	165	88	58	69	62	85	96
4	287	225	194	713	266	158	88	60	67	62	85	76
5	291	225	217	665	266	158	80	58	69	58	90	90
6	291	221	249	643	266	172	78	58	69	60	76	85
7	287	217	332	610	270	158	83	60	64	62	85	85
8	283	217	395	599	287	151	78	58	64	64	73	85
9	283	217	755	560	291	144	83	52	64	45	85	80
10	291	217	1,040	538	261	118	80	54	60	62	83	83
11	291	217	1,370	511	249	144	76	52	60	64	80	73
12	291	209	1,790	484	253	141	76	51	58	62	76	80
13	283	209	2,270	456	241	125	74	58	56	60	76	78
14	278	217	2,860	425	241	131	71	67	58	58	85	78
15	278	209	3,760	445	241	131	71	69	58	60	85	80
16	283	209	3,530	430	257	125	71	74	58	51	80	76
17	283	206	3,080	425	300	118	71	74	60	58	80	78
18	287	209	2,860	462	274	112	76	71	56	62	85	73
19	287	217	2,640	467	283	104	71	71	58	58	90	80
20	287	209	2,510	478	300	96	71	69	54	67	85	76
21	274	209	2,220	472	318	88	74	67	54	71	90	76
22	274	202	1,980	467	300	90	71	67	52	74	96	71
23	266	202	1,810	467	291	85	71	67	52	74	96	71
24	257	209	1,630	450	274	83	64	67	49	76	85	67
25	249	202	1,460	420	257	90	64	64	45	80	96	54
26	245	202	1,330	395	233	115	67	64	56	83	96	54
27	241	209	1,190	385	221	151	69	64	56	85	88	67
28	241	209	1,100	385	202	144	67	64	52	88	96	67
29	241	.....	1,020	355	190	134	69	64	52	88	96	67
30	241	.....	953	332	179	115	64	69	52	74	96	67
31	233	.....	881	.....	172	.....	64	69	.....	85	.....	67

NOTE.—These discharges are based on a well-defined rating curve.

Monthly discharge of Crow River at Rockford, Minn., for 1910.

[Drainage area, 2,520 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	291	233	274	0.109	0.13	B.
February	233	202	214	.085	.09	B.
March	3,760	194	1,490	.591	.68	A.
April	833	332	514	.204	.23	A.
May	318	172	261	.104	.12	A.
June	172	83	130	.052	.06	A.
July	107	64	75.2	.030	.03	A.
August	74	51	63.5	.025	.03	B.
September	69	45	58.5	.023	.03	B.
October	88	45	66.3	.026	.03	B.
November	96	73	86.3	.034	.04	B.
December	96	54	76.2	.030	.04	B.
The year	3,760	45	276	.109	1.51	

SOUTH FORK OF CROW RIVER NEAR ROCKFORD, MINN.

This station, which is located at the highway bridge 3½ miles southwest of Rockford, in sec. 1, T. 118 N., R. 25 W., and 2 miles above the junction of the North and South forks, was established June 15, 1909, on account of power available on the river, and also to obtain a check (in connection with the North Fork station) on the records at Rockford on the main stream.

No tributaries enter within several miles of the station. The nearest dam is that at Delano, which is used merely as a diversion dam for the Great Northern Railway. The station is slightly within the influence of the dam at Rockford on the main river, but as there are no flashboards on this dam and no sluice gates, the control is nearly permanent as long as the dam remains unchanged.

During all stages except low, discharge measurements are made from the bridge at which the staff gage is located; at low stages measurements are made by wading a short distance upstream.

Ice is present at this station from December to March, inclusive, and observations are then discontinued.

The datum of the gage has remained unchanged since the gage was installed, but from July 27 to August 10, 1909, when the dam at Rockford was open for repairs, conditions of flow were temporarily changed.

Conditions at this station are favorable for good results, and the records should be reliable.

Discharge measurements of South Fork of Crow River near Rockford, Minn., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 16	C. J. Emerson	135	734	7.40	1,920
July 14[a]	G. A. Gray	92	89.9	1.40	57.8
Sept. 9[a]	C. R. Adams	9	2.9	.60	2.5

[a] Wading measurement.

Daily gage height, in feet, of South Fork of Crow River near Rockford, Minn., for 1910.

[Jacob Horsch, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	3.11	2.16	1.88	1.70	0.75	0.72	0.62	1.22
2	.....	3.02	2.18	1.88	1.74	.66	.72	.62	1.21
3	.....	2.91	2.12	1.90	1.74	.70	.70	.66	1.22
4	.....	2.86	2.08	1.89	1.70	.70	.69	.70	1.21
5	.....	2.79	2.09	1.89	1.70	.69	.69	.74	1.18
6	2.50	2.76	2.10	1.90	1.68	.70	.65	.79	1.25
7	2.78	2.70	2.10	1.90	1.58	.69	.64	.76	1.26
8	3.18	2.62	2.10	1.84	1.48	.69	.65	.79	1.31
9	3.98	2.60	2.08	1.81	1.45	.69	.60	.85	1.36
10	4.32	2.54	2.02	1.86	1.60	.70	.60	.90	1.32
11	4.86	2.50	2.01	1.88	1.58	.68	.60	.90	1.21
12	5.48	2.45	2.00	1.86	1.54	.68	.60	.90	1.18
13	6.28	2.45	1.98	1.82	1.50	.94	.60	.90	1.24
14	7.10	2.38	1.96	1.85	1.42	.96	.60	.89	1.30
15	8.60	2.36	1.95	1.81	1.35	1.09	.60	.89	1.30
16	7.52	2.31	1.96	1.76	1.35	.99	.60	1.01	1.28
17	6.90	2.38	2.02	1.74	1.35	1.00	.60	1.02	1.30
18	6.50	2.42	2.02	1.72	1.34	1.01	.60	1.06	1.28
19	6.11	2.41	2.04	1.76	1.31	.96	.60	1.21	1.22
20	5.70	2.42	2.11	1.74	1.26	1.01	.60	1.21	1.24
21	5.32	2.44	2.15	1.71	1.26	1.10	.60	1.22	1.26
22	4.94	2.46	2.12	1.70	1.15	1.06	.60	1.29	1.24
23	4.68	2.46	2.10	1.68	1.14	.94	.60	1.39	1.32
24	4.38	2.44	2.09	1.66	1.30	.82	.60	1.36	1.44
25	4.15	2.38	2.04	1.66	1.28	.76	.60	1.32	1.44
26	3.98	2.34	1.99	1.85	1.22	.75	.68	1.35	1.41
27	3.71	2.30	1.99	1.91	1.12	.72	.68	1.32	1.51
28	3.52	2.29	1.98	1.84	1.10	.70	.66	1.29	1.42
29	3.45	2.29	1.95	1.79	1.08	.71	.62	1.22	.....
30	3.25	2.22	1.92	1.71	.95	.74	.62	1.32	.....
31	3.18	.....	1.89	.....	.76	.70	.....	1.31	.....

NOTE.—Ice present from Jan. 1 to Mar. 5 and from Nov. 24 to Dec. 31.

Daily discharge, in second-feet, of South Fork of Crow River near Rockford, Minn., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept	Oct.	Nov.
1	.....	315	136	100	79	8	6.8	3.2	34
2	.....	295	139	100	83	4.6	6.8	3.2	33
3	.....	270	131	102	83	6	6	4.6	34
4	.....	260	125	101	79	6	5.6	6	33
5	.....	245	127	101	79	5.6	5.6	7.6	31
6	190	239	128	102	77	6	4.2	9.6	36
7	243	227	128	102	66	5.6	3.9	8.4	37
8	331	212	128	95	56	5.6	4.2	9.6	41
9	525	208	125	91	54	5.6	2.5	12	45
10	626	197	118	97	68	6	2.5	14	42
11	801	190	116	100	66	5.3	2.5	14	33
12	1,040	182	115	97	62	5.3	2.5	14	31
13	1,390	182	112	92	58	16	2.5	14	35
14	1,800	170	110	96	51	17	2.5	14	40
15	2,650	167	108	91	44	24	2.5	14	40
16	2,020	159	110	86	44	18	2.5	19	38
17	1,700	170	118	83	44	19	2.5	20	40
18	1,500	176	118	81	44	20	2.5	23	38
19	1,310	175	120	86	41	17	2.5	33	34
20	1,130	176	129	83	37	20	2.5	33	35
21	978	180	135	80	37	25	2.5	34	37
22	829	183	131	79	28	23	2.5	39	35
23	738	183	128	77	28	16	2.5	48	42
24	644	180	127	75	40	11	2.5	45	.....
25	575	170	120	75	38	8.4	2.5	42	.....
26	525	163	114	96	34	8	5.3	44	.....
27	458	157	114	103	26	6.8	5.3	42	.....
28	412	156	112	95	25	6	4.6	39	.....
29	395	156	108	89	24	6.4	3.2	34	.....
30	348	145	105	80	16	7.6	3.2	42	.....
31	331	.....	101	.....	8.4	6	.....	41	.....

NOTE.—Daily discharge computed from a fairly well-defined rating curve.

Monthly discharge of South Fork of Crow River near Rockford, Minn., for 1910.

[Drainage area, 1,160 square miles.]

Month	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
March (6–31)	2,650	190	903	0.778	0.75	B.
April	315	145	196	.169	.19	B.
May	139	101	121	.104	.12	B.
June	103	75	91.2	.079	.09	B.
July	83	8.4	49	.042	.05	B.
August	25	4.6	11.1	.0096	.01	A.
September	6.8	2.5	3.57	.0031	.003	A.
October	48	3.2	23.4	.020	.02	B.
November	45	.....	[a]37	.032	.04	C.

[a] Mean discharge Nov. 24 to 30 estimated at 38 second-feet.

RUM RIVER.

GENERAL FEATURES OF AREA DRAINED.

The area drained by Rum River lies east of the central part of Minnesota, chiefly in Mille Lacs, Isanti, and Anoka counties. Rum River rises in Lake Mille Lacs (207 square miles in area), and for 16 miles flows through three lakes bordered by flat, marshy shores; the

entire fall in this distance being not more than 2 feet. Below the lakes the river winds southward as far as Princeton, where it is joined by the West Branch. Below Princeton it flows eastward in a still more winding course until it reaches Cambridge, where it turns to the south and enters the Mississippi at Anoka.

For a distance of 50 miles below the lakes the fall of the river is heavy, but from Bogus Brook to the St. Francis Dam the fall is slight. From St. Francis to Cedar Creek, a distance of 10 miles, there is considerable fall, but below this point the slope is very flat, as the influence of the Anoka dam reaches nearly to this point. Along the upper stretch of the river the banks are low, but their height gradually increases and at Page they are 20 to 30 feet above the water surface. They continue high to Princeton, are low between that point and Cambridge, and below Cambridge rise again to a general height of 20 feet or more.

The principal tributaries are West Branch, Tibbetts, Bogus, and Spencer brooks, and Upper and Lower Stanchfield and Cedar creeks. With the exception of the West Branch the streams are small.

The following drainage areas have been measured in the basin:

Drainage areas, in square miles, in Rum River basin.

River.	Above—	Drainage area.
		Sq. miles.
Rum River	Mille Lacs Lake outlet	378
Do	Onamia	414
Do	Sec. 10, T. 39 N., R. 27 W	544
Do	Sec. 27, T. 39 N., R. 27 W	601
Do	Sec. 34, T. 37 N., R. 26 W	721
Do	Cambridge	1,160
Do	Cedar Creek	1,360
Do	Mouth	1,550

The general surface of the basin is level or gently undulating. There are but few lakes except Mille Lacs and 20 small lakes in the immediate vicinity, which have a combined water surface of 240 square miles. Altitudes range from 850 to 1,300 feet above sea level. The area is covered by a thick glacial deposit of red till, beneath which are Archean granites and gneisses or Upper Cambrian sandstones and limestones. Along the Rum River valley are deposits of modified drift composed of sand and gravel. Rock is exposed only at a few places along upper Rum River and the West Branch.

Below Princeton the greater part of the area is under cultivation, but between Princeton and Milaca the proportion of cleared and cultivated land becomes smaller, and above Milaca, except for isolated clearings and farms along the river, the area is covered with brush.

The mean annual rainfall is about 27 inches, of which 3 inches are precipitated in the form of snow that remains throughout the winter. The streams are frozen over from December to March and during that period the flow is very uniform. As no thaws occur during the winter there are no freshets. The flow gradually decreases to midwinter when it is minimum, remaining constant until the spring breakup.

Lake Mille Lacs forms a natural reservoir for Rum River, tending to equalize its flow. In years of very low flow, however, this regulation is detrimental to the river, as of the area at the outlet more than half is comprised within the lake surface itself, where evaporation exceeds precipitation by 6 inches or more. This loss must be made up from the small tributary run-off. The effect of this is seen in the period of low rainfall from the spring of 1910 to the summer of 1911. The run-off at Onamia, which included not only Mille Lacs but the three small lakes below its outlet, was very small and ceased entirely during the winter. During the greater portion of this period there was said to be no flow from Mille Lacs, the flow past Onamia representing the area below the lake.

In order to determine the storage available in Lake Mille Lacs a survey was made in 1909. From the data collected on this survey a map has been prepared, showing the shore line of the lake, adjacent topography, and the depth of the lake in many places. This map may be had by applying to the district engineer, United States Geological Survey, Old Capitol Building, St. Paul, Minn.

In order to determine the availability of Rum River for power development, a survey was made during 1909 from Anoka to the outlet of Lake Onamia at Onamia. From the data collected on this survey sheets have been prepared showing a profile of the water surface, a plan of the river, and the contours along the river bank. The results of this survey have been published in separate sheets which may be obtained by applying to the district engineer, United States Geological Survey, Old Capitol Building, St. Paul, Minn. From this survey the following table of elevations and distances has been compiled:

Elevations and distances along Rum River.

Point.	Distance above mouth.	Elevation above sea level.
	Miles.	*Feet.*
Mississippi River	0	832
Anoka, tailwater	1	833
Anoka, headwater	1	845
Range line 24–25 W	10	848
Gillespie Bridge	16	865
Seely Brook	19	873
St. Francis, tailwater	22	885
St. Francis, headwater	22	894
Bethel Bridge	27	895
Isanti Bridge	34	896

Elevations and distances along Rum River—Continued.

Point.	Distance above mouth.	Elevation above sea level.
	Miles.	*Feet.*
Cambridge Bridge	42	899
Lower Stanchfield Creek	49	902
Range line 23–24 W	53	907
Findell Bridge	59	912
Range line 24–25 W	65	919
Spencer Brook	72	930
Isanti-Sherburne County line	78	938
Sherburne-Mille Lacs County line	84	947
Princeton Bridge	87	951
Section line 9–16	93	960
Bogus Brook	100	973
Section line 15–22	103	987
Vandell Brook	105	996
Township line 37–38 N	110	1,028
Milaca, tailwater	112	1,040
Milaca, headwater	112	1,045
Highway Bridge	114	1,057
Mike Dreur Brook	117	1,085
Whitney Brook	122	1,121
Page Brook	126	1,152
Hanson Brook	132	1,193
Highway Bridge	136	1,225
Onamia Bridge	142	1,249

Water power is utilized at St. Francis, where a fall of 10 feet develops 75 horsepower, and at Anoka, where a fall of 14 feet furnishes 250 horsepower.

Logging dams exist at various points, but they have been abandoned, as logs are no longer driven down the river.

RUM RIVER AT ONAMIA, MINN.

This station, which is located at the steel highway bridge about 300 feet below the "Soo" Railway bridge at Onamia and 200 yards below the outlet of Lake Onamia, was established September 24, 1909, to ascertain the run-off from Lake Mille Lacs and the chain of three lakes into which it discharges. A station was established at the outlet of Mille Lacs proper, 12 miles above Onamia, but conditions of flow were so unstable that the gage heights did not serve as a true index of the flow and that station was therefore abandoned in favor of the station at Onamia. The records will show the run-off from Lake Onamia that would be available for storage and indicate the flow throughout the upper portion of Rum River—the section of river having the greatest fall—available for hydraulic development.

The nearest important tributary, Bradbury Brook, enters Rum River 5 miles below the station.

Two miles below Onamia is an abandoned logging dam which raises the water level about 3 feet but does not control the flow, and owing to the fall of the river the influences of this dam do not reach the gaging station.

The gage was located originally at the wooden highway bridge just below the "Soo" Railway bridge, but May 4, 1910, this bridge was

destroyed and the gage moved downstream to the steel highway bridge. The new gage was set to read the same as the old one.

Discharge measurements are made from the steel highway bridge.

Owing to the natural storage afforded by the lakes the range of stage at Onamia is slight.

At the original location there was practically no ice during the winter and discharge measurements showed that the open-season rating curve applied. At the present location, however, the river freezes over.

Conditions of flow are favorable for good results and the records of flow should be reliable, as the station is well rated.

Discharge measurements of Rum River at Onamia, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Sept. 24	Follansbee and Adams	39	29.0	0.72	103
Nov. 8	C. J. Emerson	72	66.3	.73	98.4
1910.					
Jan. 28	G. A. Gray	55	60.0	.68	68.3
Mar. 30	do	71	139	1.22	386
May 4	do	74	108	1.05	261
5	do	74	105	1.00	246
July 19[a]	Robert Follansbee	28	12.6	.48	20.6
20[a]	do	23	12.6	.49	20.3
Sept. 24[a]	C. R. Adams	20	3.8	.14	3.9

[a] Wading section.

Daily gage height, in feet, of Rum River at Onamia, Minn., in 1910.

[R. Swedburg, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.58	0.68	0.68	1.22	1.05	0.98	0.65	0.50	0.32	0.25	0.28	0.12
2	.....	.68	.68	1.20	1.05	.98	.62	.50	.32	.25	.28	.12
3	.....	.68	.68	1.18	1.05	.95	.60	.50	.30	.25	.25	.12
4	.....	.68	.68	1.18	1.05	.95	.60	.50	.28	.22	.25	.12
5	.58	.68	.68	1.20	1.02	.92	.58	.48	.28	.22	.22	.10
6	.....	.68	.68	1.20	1.02	.90	.55	.48	25	22	20	.10
7	.....	.68	.68	1.20	1.02	.90	.52	.48	.25	.20	.20	.10
8	.60	.68	.70	1.18	1.02	.88	.50	.48	.25	.20	.20	.....
9	.....	.68	.70	1.15	1.00	88	.50	.48	.22	.18	.20	.....
10	.....	.68	.70	1.15	1.00	.85	.50	.45	.22	.18	.18	.....
11	.....	.68	.70	1.15	.98	.85	.50	.45	.22	.18	.18	.....
12	.60	.68	.70	1.15	.95	.82	.50	.48	.22	.20	.18	.....
13	.....	.65	.72	1.15	.95	.82	.48	.48	.20	.20	.15	.....
14	.....	.65	.75	1.15	.92	.80	.48	.48	.20	.20	.15	.....
15	.65	.65	.78	1.18	.92	.80	.50	.45	.20	.20	.15	.....
16	.65	.65	.80	1.20	.92	.78	.50	.42	.20	.20	.15	.....
17	.65	.65	.85	1.20	.95	.75	.50	.42	.20	.20	.15	.....
18	.65	.65	.88	1.18	.95	.72	.50	.42	.20	.20	.15	.....
19	.68	.65	.90	1.18	.95	.70	.50	.42	.20	.22	.15	.....
20	.70	.65	.95	1.15	.95	.68	.50	.40	.18	.22	.15	.....
21	.70	.65	1.00	1.15	.95	.68	.50	.40	.18	.22	.15	.....
22	.68	.65	1.05	1.15	.92	.62	.50	.40	.15	.22	.15	.....
23	.68	.65	1.08	1.12	92	.58	.50	.40	.15	.25	.15	.....
24	.68	.68	1.10	1.10	.92	.58	.50	.38	.12	.25	.15	.....
25	.68	.68	1.15	1.10	.95	.55	.50	.38	.12	.28	.15	.....
26	.68	.68	1.20	1.10	.95	.58	.50	.38	.12	.28	.15	.....
27	.68	.68	1.20	1.08	.98	.60	.50	.38	.15	.30	.12	.....
28	.68	.68	1.22	1.08	.98	.62	.50	.38	.18	.30	.12	.....
29	.68	.....	1.22	1.08	1.00	.65	.50	.35	.20	.30	.12	.....
30	.68	.....	1.22	1.08	1.00	.68	.50	.35	.24	.30	.12	.....
31	.68	.....	1.22	.....	1.00	.....	.50	.35	.....	.30	.....	.....

NOTE.—No ice until Dec. 8, when river froze over. Ice from Dec. 8–Dec. 31.

Daily discharge, in second-feet, of Rum River at Onamia, Minn., for 1909–10.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1										94	94	154
2										94	94	154
3										94	94	180
4										94	94	180
5										94	94	167
6										94	94	154
7										94	94	141
8										94	94	128
9										94	94	108
10										94	106	88
11										106	106	68
12										106	106	68
13										128	106	68
14										180	119	68
15										239	138	57
16										180	154	57
17										170	154	57
18										154	154	57
19										154	154	55
20										138	138	54
21										138	138	52
22										128	138	50
23										119	138	50
24									94	106	138	50
25									94	94	128	50
26									94	94	128	50
27									94	94	128	48
28									94	94	128	47
29									94	94	138	45
30									94	94	138	45
31										94		45
1910.												
1	45	78	78	387	272	227	68	25	9.6	7.0	7.9	3.5
2	45	78	78	372	272	227	57	25	9.6	7.0	7.9	3.5
3	45	78	78	359	272	216	50	25	8.5	7.0	7.0	3.5
4	45	78	78	359	272	210	50	25	7.9	6.1	7.0	3.5
5	45	78	78	372	252	192	45	23	7.9	6.1	6.1	3.0
6	47	78	78	372	252	180	38	23	7.0	6.1	5.5	3.0
7	48	78	78	372	252	180	30	23	7.0	5.5	5.5	3.0
8	50	78	85	359	252	170	25	23	7.0	5.5	5.5	3.0
9	50	78	85	338	239	170	25	23	6.1	5.0	5.5	3.0
10	50	78	85	338	239	154	25	20	6.1	5.0	5.0	3.0
11	50	78	85	338	227	154	25	20	6.1	5.0	5.0	3.0
12	50	78	85	338	210	138	25	23	6.1	5.5	5.0	3.0
13	56	68	94	338	210	138	23	23	5.5	5.5	4.2	3.0
14	62	68	106	338	192	128	23	23	5.5	5.5	4.2	3.0
15	68	68	119	359	192	128	25	20	5.5	5.5	4.2	3.0
16	68	68	128	372	192	119	25	16	5.5	5.5	4.2	3.0
17	68	68	154	372	210	106	25	16	5.5	5.5	4.2	3.0
18	68	68	170	359	210	94	25	16	5.5	5.5	4.2	3.0
19	78	68	180	359	210	85	25	16	5.5	6.1	4.2	3.0
20	85	68	210	338	210	78	25	14	5.0	6.1	4.2	3.0
21	85	68	239	338	210	78	25	14	5.0	6.1	4.2	3.0
22	78	68	272	338	192	57	25	14	4.2	6.1	4.2	3.0
23	78	68	292	318	192	45	25	14	4.2	7.0	4.2	3.0
24	78	78	305	305	192	45	25	13	3.5	7.0	4.2	3.0
25	78	78	338	305	210	38	25	13	3.5	7.9	4.2	3.0
26	78	78	372	305	210	45	25	13	3.5	7.9	4.2	2.5
27	78	78	372	292	227	50	25	13	4.2	8.5	3.5	2.5
28	78	78	387	292	227	57	25	13	5.0	8.5	3.5	2.5
29	78	.....	387	292	239	68	25	11	5.5	8.5	3.5	2.5
30	78	.....	387	292	239	78	25	11	6.7	8.5	3.5	2.5
31	78	.....	387	.....	239	.....	25	11	.....	8.5	.....	2.5

NOTE.—Daily discharge computed from a well-defined rating curve, except during December, 1910, for which period it is estimated.

Monthly discharge of Rum River at Onamia, Minn., for 1909–10.

[Drainage area, 414 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
Sept. 24–30	94	94	94.0	0.227	0.06	B.
October	239	94	118	.285	.33	B.
November	154	94	121	.292	.33	B.
December	180	45	83.7	.202	.23	B.
1910.						
January	85	45	64.1	.155	.18	B.
February	78	68	74.1	.179	.19	B.
March	387	78	189	.457	.53	B.
April	387	292	341	.824	.92	B.
May	272	192	226	.546	.63	B.
June	227	38	122	.295	.33	A.
July	68	23	30.1	.073	.08	A.
August	25	11	18.1	.044	.05	A.
September	9.6	3.5	5.92	.014	.02	A.
October	8.5	5.0	6.47	.016	.02	A.
November	7.9	3.5	4.86	.012	.01	A.
December	3.5	2.5	[a]3.00	.007	.008	D.
The year	387	2.5	90.4	.218	2.97	

[a] Estimated.

RUM RIVER AT CAMBRIDGE, MINN.

This station, which is located at the highway bridge one-half mile west of Cambridge, was established June 12, 1909, to obtain data for use in studies of power and sewage-disposal problems on Rum River.

No tributary enters within several miles of Cambridge. At St. Francis, 20 miles below Cambridge by river, there is a 10-foot dam and power plant. Between the crest of the dam and the water surface at the gaging station there is a difference in elevation of about 6 feet. The fact that the morning and evening gage heights during the low-water period show no consistent change, being for the most part the same, indicates that the St. Francis dam has little effect on the flow at this point, even though the flow may fall below the crest during certain portions of the day. The only dam above Cambridge is one at Milaca, which is used to form a pool from which water is pumped.

From December to March discharge measurements are made through the ice to determine the winter flow.

The staff gage is located at the bridge from which the discharge measurements are made. Its datum has remained unchanged since the station was established. As conditions at this station are favorable the results should be good and the records should be reliable.

Discharge measurements of Rum River at Cambridge, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 12	G. A. Gray	111	599	6.45	1,040
July 10	do	97	319	3.90	330
Aug. 31	Robert Follansbee	80	227	3.14	146
1910.					
Jan. 15	G. A. Gray	84	297	[a] 4.20	170
Mar. 1	do	99	214	[b] 4.20	137
Apr. 1	do	110	421	5.40	741
June 21	Robert Follansbee	84	174	2.82	131
Aug. 3	G. A. Gray	62	142	2.50	74.2
Dec. 28	C. R. Adams	90	114	[c] 2.95	44.3

[a] Gage height to water surface; thickness of ice, 0.94 foot.
[b] Gage height to water surface; thickness of ice, 1.44 feet.
[c] Gage height to water surface; thickness of ice, 0.90 foot.

Daily gage height, in feet, of Rum River at Cambridge, Minn., for 1910.

[Martin Lofstrom, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.22	.....	4.20	5.39	3.99	3.28	2.84	2.50	2.54	2.65	2.50	2.65
2	.....	4.32	4.20	5.30	3.92	3.25	2.79	2.52	2.55	2.65	2.52	2.60
3	.....	.....	.....	5.21	3.91	3.22	2.72	2.52	2.56	2.61	2.52	2.58
4	.....	.....	.....	5.10	3.88	3.20	2.70	2.46	2.58	2.60	2.52	.....
5	4.20	.....	4.32	4.98	3.85	3.21	2.68	2.45	2.56	2.59	2.54	.....
6	.....	4.30	.....	4.88	3.78	3.29	2.66	2.44	2.58	2.52	2.45	2.62
7	.....	.....	.....	4.85	3.64	3.30	2.62	2.46	2.58	2.56	2.46	.....
8	4.18	.....	.....	4.82	3.69	3.28	2.61	2.48	2.54	2.51	2.45	.....
9	.....	4.25	4.65	4.72	3.64	3.25	2.60	2.51	2.52	2.50	2.55	2.70
10	.....	.....	.....	4.61	3.62	3.21	2.61	2.44	2.52	2.50	2.35	.....
11	.....	.....	.....	4.50	3.61	3.16	2.61	2.45	2.51	2.48	2.45	.....
12	4.18	4.20	5.00	4.45	3.56	3.10	2.62	2.48	2.52	2.48	2.36	.....
13	.....	.....	5.35	4.42	3.52	3.08	2.62	2.51	2.52	2.48	2.51	2.70
14	.....	.....	5.65	4.36	3.52	3.04	2.60	2.54	2.52	2.48	2.58	.....
15	4.20	.....	5.92	4.35	3.49	3.00	2.59	2.56	2.50	2.48	2.48	.....
16	.....	4.18	6.42	4.31	3.45	2.98	2.55	2.59	2.50	2.46	2.46	2.75
17	.....	.....	7.06	4.29	3.52	2.94	2.52	2.68	2.50	2.48	2.38	.....
18	.....	.....	7.42	4.32	3.65	2.89	2.52	2.70	2.48	2.49	2.49	.....
19	4.28	4.12	7.22	4.38	3.68	2.85	2.52	2.68	2.48	2.60	2.56	.....
20	.....	.....	7.16	4.40	3.74	2.81	2.50	2.65	2.48	2.56	2.58	2.80
21	.....	.....	7.15	4.45	3.72	2.80	2.48	2.65	2.50	2.56	2.55	.....
22	4.28	.....	7.10	4.45	3.72	2.75	2.48	2.64	2.48	2.55	2.51	.....
23	.....	4.18	6.99	4.32	3.71	2.71	2.52	2.59	2.45	2.55	2.55	2.88
24	.....	.....	6.78	4.31	3.69	2.66	2.64	2.58	2.45	2.55	2.58	.....
25	.....	.....	6.55	4.38	3.64	2.69	2.62	2.58	2.48	2.55	2.56	.....
26	4.30	4.18	6.32	4.39	3.58	2.70	2.59	2.59	2.62	2.55	2.55	.....
27	.....	.....	6.19	4.28	3.58	2.72	2.56	2.55	2.70	2.55	2.54	2.95
28	.....	.....	6.00	4.18	3.54	2.79	2.58	2.52	2.69	2.54	2.64	2.95
29	4.30	.....	5.84	4.09	3.45	2.84	2.56	2.51	2.70	2.52	2.48	.....
30	.....	.....	5.68	4.05	3.38	2.85	2.54	2.54	2.64	2.50	2.58	2.95
31	.....	.....	5.52	.....	3.34	.....	2.54	2.54	.....	2.52	.....	.....

NOTE.—Ice present from Jan. 1 to Mar. 11 and from Dec. 4 to 31.

Daily discharge, in second-feet, of Rum River at Cambridge, Minn., for 1909–10.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1							724	314	156	297	227	.....
2							667	280	156	290	240	.....
3							583	259	156	278	242	.....
4							527	252	149	273	236	.....
5							485	236	153	273	236	.....
6							458	220	158	264	236	.....
7							418	209	145	249	231	.....
8							391	227	145	242	227	.....
9							352	229	162	245	220	.....
10							327	249	156	254	227	.....
11							317	292	156	259	227	.....
12						1,040	337	302	166	283	220	.....
13						956	330	317	168	268	220	.....
14						898	314	399	179	273	302	.....
15						855	300	428	183	290	373	.....
16						826	276	394	170	290	434	.....
17						812	256	352	162	278	485	.....
18						797	242	314	164	278	472	.....
19						797	227	283	187	268	460	.....
20						754	245	252	185	256	448	.....
21						696	409	240	283	266	438	.....
22						667	469	213	535	254	429	.....
23						870	431	205	547	249	419	.....
24						1,030	472	200	544	249	410	.....
25						1,130	502	191	510	249	400	.....
26						1,160	463	187	444	242	391	.....
27						1,130	409	183	401	233	442	.....
28						1,060	365	183	365	227	455	.....
29						942	375	183	340	227	381	.....
30						840	352	176	322	231	391	.....
31						.....	332	156	.....	227	.....	.....
1910.												
1			135	742	372	211	130	78	84	99	78	100
2			135	717	354	205	121	81	85	99	81	92
3			135	692	352	199	110	81	86	94	81	89
4			140	661	344	195	107	73	89	92	81	.....
5			140	629	337	197	104	72	86	91	84	.....
6			150	602	320	213	101	71	89	81	72	.....
7			200	594	287	215	95	73	89	86	73	.....
8			250	585	299	211	94	76	84	79	72	.....
9			300	558	287	205	92	79	81	78	85	.....
10			400	530	283	197	94	71	81	78	60	.....
11			500	501	280	187	94	72	79	76	72	.....
12			634	488	269	176	95	76	81	76	61	.....
13			731	480	260	172	95	79	81	76	79	.....
14			815	465	260	165	92	84	81	76	89	.....
15	[a] 170		892	462	254	158	91	86	78	76	76	.....
16			1,040	452	246	154	85	91	78	73	73	.....
17			1,230	446	260	147	81	104	78	76	64	.....
18			1,340	454	290	138	81	107	76	77	77	.....
19			1,280	470	296	132	81	104	76	92	86	.....
20			1,260	475	311	125	78	100	76	86	89	.....
21			1,260	488	306	123	76	100	78	86	85	.....
22			1,240	488	306	115	76	98	76	85	79	.....
23			1,210	454	303	109	81	91	72	85	85	.....
24			1,140	452	299	101	98	89	72	85	89	.....
25			1,080	470	287	106	95	89	76	85	86	.....
26			1,010	472	274	107	91	91	95	85	85	.....
27			970	444	274	110	86	85	107	85	84	.....
28			915	419	265	121	89	81	106	84	98	[a] 44
29			869	396	246	130	86	79	107	81	76	.....
30			823	386	231	132	84	84	98	78	89	.....
31			779	.....	223	.....	84	84	.....	81	.....	.....

[a] Discharge measurement.

NOTE.—Daily discharge computed from a fairly well defined rating curve, except Mar. 1 to 11, 1910, for which period it was estimated.

Monthly discharge of Rum River at Cambridge, Minn., for 1909–10.

[Drainage area, 1,160 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
June 12–30	1,160	667	908	0.783	0.55	A.
July	724	227	399	.344	.40	A.
August	428	156	256	.221	.25	A.
September	547	145	252	.217	.24	A.
October	297	227	260	.224	.26	A.
November	485	220	337	.291	.32	B.
December			a 210	.181	.21	C.
1910.						
January			a 155	.134	.15	C.
February			a 145	.125	.13	C.
March	1,340	135	742	.640	.74	B.
April	742	386	516	.445	.50	B.
May	372	223	290	.250	.29	B.
June	215	101	159	.137	.15	A.
July	130	76	92.5	.080	.09	A.
August	107	71	84.8	.073	.08	A.
September	107	72	84.2	.073	.08	A.
October	99	73	83.3	.072	.08	A.
November	98	60	79.6	.067	.07	A.
December	100		a 55.0	.047	.05	D.
The year	1,340		207	.178	2.41	

a Estimated.

MINNESOTA RIVER.

GENERAL FEATURES OF AREA DRAINED.

Minnesota River, by far the largest tributary of the Mississippi in the State of Minnesota, drains an area comprising 16,600 square miles and extending nearly across the southern part of the State from west to east. The river rises on the eastern slope of the Dakota foothills (Coteau des Prairies) in the northeastern part of Marshall County, S. Dak., about 30 miles west of Lake Traverse, at an approximate elevation of 1,896 feet above sea level, and flows southeastward to the State border, where it enters Big Stone Lake, a body of water 26 miles long, 1 to 1½ miles wide, and exceeding 15 feet in depth at only a few places. In this portion of its course it is a mere mountain torrent, whose fall in 40 miles is about 900 feet and whose bed is often entirely dry; for this reason perhaps Big Stone Lake has commonly been considered its source. Emerging from Big Stone Lake at Ortonville the Minnesota flows southeastward 225 miles to Mankato, where it turns abruptly and flows northeastward to its junction with the Mississippi a few miles below the falls of St. Anthony, between the cities of Minneapolis and St. Paul.

From Big Stone Lake to the upper end of Marsh Lake, a distance of 22 miles, the river winds through a valley 1½ miles wide and 50 to 100 feet below the general level of the basin. About one-half the bottom land in this stretch is under cultivation and the other half

is marshy. At Marsh Lake, which was formed by the alluvium deposited at its lower end by Pomme de Terre River, the valley broadens to 3 miles. The lake, which is 4 miles long by 1 mile wide, is mostly filled with marsh grass, and the greater portion of the valley surface is marshy. From Marsh Lake to Lac Qui Parle, which was formed by Lac Qui Parle River as Marsh Lake was formed by the Pomme de Terre, the valley is 1 to 1½ miles wide. At Lac Qui Parle, which is about 8 miles long and three-fourths mile wide, the valley is 1½ miles wide and lies 100 feet below the general surface level. From the outlet of Lac Qui Parle to the line between ranges 30 and 40, the valley is three-fourths of a mile wide. Much of the area consists of marsh and ponds and not more than a third of it is under cultivation. In the next 6 miles the valley widens out to 2 miles and its character changes, as granite outcrops at many places. Little of the land is under cultivation. From the lower end of this wide section in T. 115 N., R. 39 W., to Mankato, the average width of the valley is 1 mile, its depth below the general level increases to 200 feet, and most of the land is under cultivation. Below Mankato the valley averages a mile in width and lies 100 to 150 feet below the surface level. From Chaska to the mouth little land is under cultivation, as it is marshy.

From Big Stone Lake to Granite Falls the slope of the river is 0.6 foot per mile except at the outlet of the lake, where the fall is heavy for a short distance. At Granite Falls and at Minnesota Falls, where granite outcrops, the river descends in falls and rapids 41 feet in a distance of 4 miles. In the 30 miles below Minnesota Falls the average slope is 1.3 feet per mile, but thence to the mouth of Cottonwood River the slope becomes much less, being only 0.5 foot per mile. From Cottonwood River to Faxon the slope increases to 1 foot per mile, but below that very point the water surface is very nearly level.

The following drainage areas have been measured on the Minnesota and its tributaries:

Drainage areas in Minnesota River basin.

River.	Above—	Drainage area.
		Sq. miles.
Minnesota	Big Stone Lake outlet	846
Do	Odessa	1,560
Do	Montevideo	6,300
Do	Sec. 30, T. 114 N., R. 36 W	7,800
Do	Sec. 33, T. 109 N., R. 28 W	11,100
Do	Mankato	14,600
Do	Mouth	16,600
Whetstone	do	441
Yellow Bank	do	536
Pomme de Terre	do	847
Lac Qui Parle	Lac Qui Parle	677
Do	Mouth	739
Chippewa	East Branch	875
Do	Mouth	1,990
Stony Run	do	176
Yellow Medicine	do	550
Hawk Creek	do	437

Drainage areas in Minnesota River basin—Continued.

River.	Above—	Drainage area.
		Sq. miles.
Redwood	Mouth	748
Cottonwood	Sleepy Eye Creek	864
Do	Mouth	1,200
Little Cottonwood	....do	180
Blue Earth	Watonwan River	1,480
Do	Rapidan Mills	2,260
Do	Mouth	3,430
Watonwan	South Branch	368
Do	Mouth	775
Le Sueur River	....do	1,160
Le Sueur Creek	....do	149
Sand Creek	....do	278

The soil in the Minnesota Valley is alluvial. Above Minneopa the river flows over the drift which covers the basin, but below that point it occupies a preglacial gorge whose bottom, filled with gravel and sand, lies 100 to 200 feet below the present bed of the river.

During the glacial epoch a vast lake, now known as Lake Agassiz, occupied the northwestern portion of the State and had outlet through Lake Traverse into Big Stone Lake, which now lies 8 feet lower than Lake Traverse, and finally into the present valley of the Minnesota. Owing to ice barriers the Minnesota did not follow its present course, but was deflected southward and reached the Mississippi through the valley of the Cannon and other rivers.

The country as a whole is flat or gently undulating, but along the southern border of the basin is a table-land 20 to 30 miles wide that rises several hundred feet above the valley and extends from southeast to northwest across the southwestern part of the State.

Elevations in the basin range from 1,000 in the valleys to 1,900 feet above sea level on the high plateau.

Except in the immediate valley of the Minnesota, the Blue Earth and one or two other tributaries, the area is covered with blue till—a confused mixture of sand, clay, and gravel—of glacial origin. The table-land on the southwestern border is capped with porous deposits of sand and gravel which supply water to the artesian wells and springs in the basin. In the western part of the basin the drift rests on Cretaceous sandstone and shales; farther east it overlies the crystalline schists and gneisses of Archean age. In the vicinity of New Ulm quartzite of Middle Cambrian age is found. Rock outcrops only along the river valleys.

Above Mankato the drainage area is prairie land; below Mankato the land was originally forested, but the greater part of it is now under cultivation.

The chief tributaries of the Minnesota are Pomme de Terre and Chippewa rivers and Chetamba Creek from the north and Lac Qui Parle, Redwood, Cottonwood, and Blue Earth rivers from the south.

Rainfall records covering periods exceeding 15 years are available for different sections of the drainage area. These records indicate that the annual rainfall ranges about 24 inches in the upper part to 28 inches in the central and lower parts. Of this amount 3 inches is precipitated in the form of snow which remains throughout the winter. The rivers are frozen over from December to March with ice 1 foot and more in thickness. The flow during the winter months is very uniform. It decreases gradually till midwinter, when the flow is a minimum. There are no winter thaws to cause sudden rises.

Big Stone Lake, which takes its name from the conspicuous granite outcrops found in the valley from 1 to 3 miles below the lake, is nearly surrounded by bluffs, and were it not for the small drainage area tributary to it, would make an excellent reservoir site. Marsh Lake and Lac Qui Parle, through which the Minnesota flows, afford reservior sites having considerably larger tributary drainage areas than Big Stone Lake. In addition to the lake in the main channel of the river, there are lakes in the upper sections of the areas drained by the Pomme de Terre and Chippewa rivers and the extreme upper parts of the basins drained by Redwood, Cottonwood, and Blue Earth rivers. Below Mankato the basin contains more lakes, many of them small and without visible outlet.

A survey of the river was made in 1909–10 by the United States Engineer Corps for the purpose of determining the feasibility of building a reservoir to increase the low-water flow, as the lower portion of the Minnesota is navigable, although it carries little traffic at present. The following table of elevations and distances has been compiled from this survey:

Elevations and distances along Minnesota River.

Place.	Distance below Big Stone Lake.	Elevation above sea level.
	Miles.	*Feet.*
Big Stone Lake	0	966
Whetstone River	2	956
Bridge southwest of Odessa	11	944
Yellow Bank River	15	940
Marsh Lake Bridge	22	936
Pomme de Terre River	29	935
Bridge southwest of Appleton	31	931
Lac Qui Parle Bridge	36	926
Lac Qui Parle River	46	924
First bridge below Lac Qui Parle	48	923
Bridge southwest of Watson	51	921
Bridge northwest of Montevideo	55	917
Chippewa River	62	913
Bridge at Montevideo	62	913
Bridge at Myers	70	910
Great Northern Ry., above Granite Falls	79	907
Pond above dam	80	906
Highway Bridge, Granite Falls	81	891
Pond above dam, Minnesota Falls	84	883
Yellow Medicine River	96	861
Hawk Creek	96	860
Sacred Heart Bridge	103	848
Sacred Heart Creek	109	835
Bridge north of Delhi	111	831

Elevations and distances along Minnesota River—Continued.

Place.	Distance below Big Stone Lake.	Elevation above sea level.
	Miles.	*Feet.*
North Redwood Bridge	122	820
Morton	132	810
Bridge south of Franklin	141	803
Fort Ridgely Bridge	158	793
Henderman Bridge	164	791
Bridge below New Ulm	189	784
Cottonwood River	192	780
Courtland Bridge	198	774
Judson Bridge	212	762
Blue Earth River	224	757
St. Peter	243	730
Ottawa	250	723
Le Sueur	258	716
Henderson	268	710
Faxon	282	700
Belle Plaine	289	696
Crest of Little Rapids	303	693
Carver	308	690
Bloomington Ferry	323	690
Mendota Bridge	339	690

Water power is developed at the following points in the drainage basin:

Developed water powers in Minnesota River basin.

Place.	Fall utilized.	Average horsepower.
	Feet.	
Minnesota River at Granite Falls	14	350
Minnesota River at Minnesota Falls	16	250
Pomme de Terre River at Appleton	14	80
Chippewa River at Millerville	.....	50
Chippewa River at Hagan	8	45
Chippewa River at Montevideo	7	75
East Branch Chippewa River at Swift Falls	20	45
East Branch Chippewa River at Terrace	16	40
Redwood River at Redwood Falls	85	150
Redwood River at North Redwood	.....	50
Cottonwood River at New Ulm	8.5	35
Blue Earth at Rapidan Mills	56	1,800

The bottom land of the Minnesota Valley is subject to overflow to such an extent that considerable tracts of it are not now under cultivation. The 1908 flood did an immense amount of damage. At that time the Mankato gage read 21.2 feet, the maximum reading since its establishment in 1903. In 1909 a survey was made by the State drainage commission for the purpose of devising a method of flood prevention, but the results of the survey have not yet been published. A report of an examination of the valley, which was made by the United States Engineer Corps, has been published as House Document 76, Forty-third Congress, second session. The only maps of the area published by the United States Geological Survey are the Barretts sheet, which includes the upper Pomme de Terre basin, and the St. Paul, Minneapolis, and Minnetonka sheets, which cover the mouth of the Minnesota.

Discharge records maintained since 1903 indicate 1910 as the driest year and 1908 the wettest year of the period. The ratio of run-off during these two years was 1 to 4.1

The quality of the water in the Minnesota Valley is described in a report entitled "The quality of surface waters in Minnesota," published by the United States Geological Survey as Water-Supply Paper 193.

An examination of Big Stone Lake as a possible reservoir site was made by the United States Engineer Corps and the results published in House Document 127, Fifty-second Congress, first session, and House Document 539, Fifty-eighth Congress, second session.

MINNESOTA RIVER NEAR ODESSA, MINN.

This station, which is located at the highway bridge 1 mile southwest of Odessa in sec. 32, T. 121 N., R. 45 W., was established July 4, 1909, for the purpose of determining the run-off from Big Stone Lake available for storage. A station was also established on Whetstone River, which enters the Minnesota above Odessa, for the purpose of determining the amount of water passing Odessa from that source.

Owing to its extreme flatness the valley immediately below Big Stone Lake is subject to overflow during high water, and it was therefore not possible to locate a satisfactory gaging station above Odessa. Even at this station some water overflows around one end of the bridge at extremely high stages, but this is only a small percentage of the entire flow.

The nearest tributary is Stony Run, a very small stream that enters from the north a half mile above the station.

The flow at Odessa is entirely uncontrolled, as the nearest dam is at Granite Falls. The river is frozen over and observations are discontinued from December to March. The flow during that period may be roughly estimated by utilizing the run-off per square mile of drainage area above Montevideo.

Since the establishment of the gage, which is attached to the bridge from which the discharge measurements are made, the datum has remained unchanged.

Conditions at this station are favorable for excellent results, and the records, therefore, should be reliable.

Discharge measurements of Minnesota River near Odessa, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 4	Robert Follansbee	36	76.5	2.98	52.7
24	G. A. Gray	33	36.9	2.65	32.8
Aug. 15	C. J. Emerson	34	40.6	2.78	42.2
Sept. 17	G. A. Gray	34	47.0	2.88	44.9
1910.					
Mar. 14	G. A. Gray	61	371	8.45	520
23	C. J. Emerson	60	252	6.54	350
Apr. 29	Robert Follansbee	61	306	7.45	435
July 9	do	31	43.6	2.26	18.0
Oct. 13[a]	C. R. Adams	32	31.1	2.50	25.5

[a] Wading measurement.

Daily gage height, in feet, of Minnesota River near Odessa, Minn., for 1910.

[Claud Shellenbarger, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	5.38	7.16	3.92	2.41	2.19	2.64	2.87	2.78
2	.....	5.20	6.66	3.84	2.46	2.20	2.46	2.76	2.75
3	.....	5.04	6.40	3.74	2.41	2.20	2.64	2.80	2.72
4	.....	5.29	6.17	3.75	2.34	2.18	2.63	2.86	2.95
5	.....	5.49	5.78	3.74	2.28	2.18	2.93	2.74	3.05
6	.....	5.15	5.63	3.78	2.36	2.19	2.66	2.69	3.05
7	.....	5.08	5.57	3.62	2.32	2.20	2.46	2.68	2.82
8	.....	4.99	5.52	3.52	2.30	2.24	2.83	2.66	2.72
9	11.60	4.95	5.43	3.64	2.30	2.20	2.80	2.66	2.66
10	10.36	4.88	5.37	3.80	2.24	2.20	2.76	2.62	2.65
11	9.62	4.80	5.30	3.71	2.26	2.21	2.74	2.67	2.60
12	9.31	4.70	5.17	3.68	2.24	2.21	2.70	2.63	2.64
13	8.92	4.56	5.04	3.68	2.21	2.22	2.64	2.63	2.70
14	8.45	4.75	4.89	3.51	2.20	2.32	2.70	2.66	2.79
15	8.28	.....	4.80	3.38	2.16	2.39	2.70	2.68	2.71
16	8.06	5.36	4.90	3.24	2.14	2.42	2.63	2.61	2.78
17	7.85	5.56	5.04	3.14	2.11	2.39	2.60	2.68	2.82
18	7.75	5.32	5.12	3.17	2.09	2.36	2.80	2.66	2.90
19	7.42	4.96	4.84	3.04	2.06	2.35	2.76	2.81	2.96
20	7.16	4.99	4.70	2.94	2.04	2.35	2.68	3.42	.....
21	6.88	5.68	4.63	2.84	2.02	2.40	2.63	3.18	.....
22	6.68	6.74	4.50	2.75	2.00	2.42	2.63	2.82	.....
23	6.56	7.18	4.44	2.78	2.08	2.42	2.83	2.78	.....
24	6.45	8.08	4.63	2.71	2.14	2.45	2.73	2.81	.....
25	6.22	8.42	4.53	2.78	2.20	2.54	2.83	2.81	.....
26	5.96	8.10	4.19	2.82	2.19	2.54	3.03	2.92	.....
27	5.76	7.98	4.09	2.77	2.16	2.52	3.13	3.15	.....
28	5.78	7.72	4.09	2.68	2.14	2.40	2.84	3.12	.....
29	5.52	7.40	4.36	2.58	2.12	2.40	2.74	3.05	.....
30	5.70	7.16	4.06	2.48	2.11	2.45	2.80	2.85	.....
31	5.46	.....	3.97	.....	2.11	2.62	.....	2.86	.....

NOTE.—Ice present from Jan. 1 to Mar. 8, and from Nov. 20 to Dec. 31.

Daily discharge, in second-feet, of Minnesota River near Odessa, Minn., for 1909–10.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1909.									
1						28	31	53	65
2						24	31	60	65
3						30	34	60	63
4					54	31	37	58	62
5					49	26	36	59	64
6					49	23	36	55	58
7					46	42	36	57	64
8					49	58	36	59	59
9					53	56	36	77	52
10					52	49	40	87	57
11					48	44	36	98	58
12					64	40	31	115	59
13					57	41	32	88	64
14					53	43	37	74	75
15					51	45	47	65	156
16					46	39	53	63	122
17					42	41	47	66	106
18					39	42	47	61	102
19					33	40	52	56	92
20					32	37	43	64	92
21					34	39	53	65	92
22					41	37	63	60	92
23					37	37	59	66	91
24					31	32	59	58	97
25					27	33	57	65	98
26					28	29	53	65	97
27					28	34	50	63	97
28					24	32	58	59	97
29					28	32	59	51	96
30					25	29	59	56	95
31					28	30		66	
1910.									
1		241	407	114	22	16	33	46	41
2		224	360	108	24	16	24	40	39
3		210	336	101	22	16	33	42	37
4		233	314	102	20	16	32	46	51
5		252	278	101	18	16	50	38	57
6		220	265	104	21	16	34	35	57
7		213	259	92	20	16	24	35	43
8		205	255	85	19	17	44	34	37
9	850	202	246	94	19	16	42	34	34
10	726	195	240	105	17	16	40	32	34
11	652	188	234	99	18	16	38	34	31
12	621	179	221	97	17	16	36	32	33
13	582	166	210	97	16	17	33	32	36
14	535	184	196	85	16	20	36	34	41
15	518	212	188	77	15	22	36	35	37
16	496	239	197	68	15	23	32	32	41
17	475	258	210	62	14	22	31	35	43
18	465	236	217	64	14	21	42	34	48
19	432	202	192	56	13	20	40	43	52
20	407	205	179	50	13	20	35	79	
21	381	269	173	44	12	22	32	65	
22	362	368	161	39	12	23	32	43	
23	351	409	156	41	14	23	44	41	
24	341	498	173	37	15	24	38	43	
25	319	532	164	41	16	28	44	43	
26	295	500	135	43	16	28	56	49	
27	276	488	127	40	15	27	62	63	
28	278	462	127	35	15	22	44	61	
29	255	430	149	30	14	22	38	57	
30	271	407	125	25	14	24	42	45	
31	249		118		14	32		46	

NOTE.—Daily discharge computed from a well-defined rating curve, except that for the last half of November, 1909, for which it is estimated.

Monthly discharge of Minnesota River near Odessa, Minn., for 1909–10.

[Drainage area, 1,560 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
July (4–31)	64	24	41.0	0.026	0.03	B.
August	58	24	36.9	.024	.03	B.
September	63	31	44.9	.029	.03	B.
October	115	51	66.1	.042	.05	B.
November	156	52	83.6	.054	.06	B.
1910.						
March (9–31)	850	249	441	.283	.24	B.
April	532	166	288	.185	.21	A.
May	407	118	213	.137	.16	A.
June	114	25	71.2	.046	.05	A.
July	24	12	16.5	.011	.01	A.
August	32	16	20.4	.013	.02	A.
September	62	24	38.2	.024	.03	A.
October	79	32	42.8	.027	.03	A.
November (1–19)	57	31	41.7	.027	.02	A.

MINNESOTA RIVER NEAR MONTEVIDEO, MINN.

This station, which is located at the highway bridge about 1 mile south of Montevideo, in sec. 19, T. 117 N., R. 40 W., was established July 23, 1909, to obtain information concerning the power available on Minnesota River at Granite Falls, a few miles below. The records will also afford data of value in connection with studies of flood prevention, navigation, and sewage disposal.

Chippewa River enters the Minnesota a short distance above the station. The nearest dam, that above Granite Falls, is not more than 6 or 8 feet high, and its influence does not extend to the Montevideo station. There is no dam above the station.

The discharge of Chippewa River is so much less than that of the Minnesota that the control of the former by a dam at Montevideo has very little effect on the Minnesota gage heights.

The river is frozen entirely across at this station from December to March, during which period discharge measurements are made through the ice to determine the approximate winter discharge.

The chain gage is attached to the bridge from which the discharge measurements are made. The datum of the gage was lowered 2 feet September 16, 1909, and again lowered 1 foot in 1910 to avoid negative readings. All readings have been corrected to conform to the datum established in 1910.

Conditions at this station are excellent, and the results should therefore be reliable.

Discharge measurements of Minnesota River near Montevideo, Minn., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 3	G. A. Gray	120	296	[a] 4.15	164
Mar. 22	C. J. Emerson	121	819	9.07	2.150
Apr. 14	G. A. Gray	102	491	6.18	1.060
July 7	Robert Follansbee	82	142	2.68	175
8	....do	82	143	2.66	172
29	....do	54	78.1	1.79	66.1
Oct. 14	C. R. Adams	59	82.7	1.89	71.5

[a] Gage height to water surface; thickness of ice, 1.26 feet.

Daily gage height, in feet, of Minnesota River near Montevideo, Minn., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.00	4.00	7.66	7.16	4.37	2.80	1.70	1.95	2.06	2.21	2.66
2	.....	.....	.....	7.49	7.17	4.38	2.82	1.85	1.70	1.93	2.16	2.65
3	4.28	4.15	.....	7.18	7.04	4.16	2.74	1.94	1.87	1.87	2.11	2.71
4	.....	4.32	5.40	7.36	6.90	4.12	2.62	2.07	1.83	2.17	1.98	2.66
5	.....	.....	5.95	7.38	6.73	4.00	2.54	1.90	1.77	1.97	2.26	2.69
6	.....	.....	6.10	7.14	6.66	4.14	2.74	1.74	1.84	2.17	2.26	2.60
7	3.80	.....	7.15	7.08	6.42	4.00	2.63	1.74	1.80	2.03	2.24	2.49
8	.....	4.05	7.76	7.06	6.22	4.12	2.65	1.74	1.79	1.97	2.29	2.52
9	.....	.....	8.10	7.02	6.37	3.98	2.58	1.77	1.99	1.97	2.34	2.60
10	.....	.....	7.45	6.72	6.27	3.90	2.42	1.83	1.80	1.87	2.29	2.61
11	4.20	4.02	8.66	6.84	6.08	4.02	2.58	1.67	1.61	1.91	2.26	2.60
12	.....	.....	8.85	6.60	5.89	4.00	2.54	1.60	1.83	1.87	2.22	2.65
13	.....	.....	9.32	6.38	5.86	4.26	2.38	1.63	1.80	1.85	2.21	2.64
14	4.40	.....	8.95	6.26	5.70	4.16	2.28	1.71	1.79	1.99	2.20	.....
15	.....	.....	8.72	6.31	5.28	4.00	2.39	1.73	1.80	1.80	2.28	2.66
16	.....	3.75	9.54	6.76	5.48	3.83	2.32	1.74	1.81	1.95	2.34	2.62
17	.....	.....	9.74	6.88	5.66	3.78	2.24	1.95	1.71	1.91	2.36	2.61
18	4.30	3.92	9.36	6.92	5.54	3.69	2.16	1.90	1.87	1.89	2.31	2.66
19	.....	.....	9.22	6.88	5.45	3.48	2.01	1.87	1.83	2.02	2.26	2.66
20	.....	.....	9.14	7.02	5.58	3.40	2.04	2.00	1.84	2.28	2.24	2.62
21	4.20	.....	9.14	7.38	5.48	3.40	2.11	1.96	1.85	2.02	2.34	2.54
22	.....	4.05	9.07	7.71	5.48	3.32	2.12	1.97	1.77	2.01	2.31	.....
23	.....	.....	8.94	8.12	5.45	3.29	1.99	2.05	1.87	2.02	2.29	.....
24	.....	.....	8.89	7.85	5.51	3.24	1.94	1.97	1.91	2.06	2.32	2.60
25	4.05	4.10	8.78	7.80	5.35	3.23	2.19	2.10	1.89	2.08	2.35	.....
26	.....	.....	8.66	7.73	5.22	3.09	1.98	2.09	2.00	2.14	2.48	.....
27	.....	.....	8.24	7.67	5.01	2.99	1.96	2.07	2.11	2.28	2.38	.....
28	4.02	.....	8.32	7.60	4.90	2.94	1.70	1.77	1.95	2.45	2.52	2.60
29	.....	.....	7.99	7.50	4.70	2.87	1.79	1.83	1.90	2.32	2.56	.....
30	.....	.....	7.91	7.43	4.91	2.82	1.86	1.69	1.86	2.08	2.61	.....
31	.....	.....	7.88	.....	4.60	.....	1.90	1.95	.....	2.15	.....	2.72

NOTE.—Ice present from Jan. 1 to Mar. 5, and from Nov. 28 to Dec. 31.

Daily discharge, in second-feet, of Minnesota River near Montevideo, Minn., for 1910.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	150	1,600	1,410	508	181	58	83	95	111
2	.....	150	1,530	1,410	511	184	73	58	81	106
3	[a] 164	160	1,420	1,360	452	173	82	75	75	100
4	.....	700	1,480	1,310	441	158	96	71	107	86
5	.....	850	1,490	1,250	410	149	78	65	85	117
6	.....	1,030	1,400	1,230	446	173	62	72	107	117
7	.....	1,310	1,380	1,140	410	160	62	68	91	114
8	.....	1,640	1,370	1,070	441	162	62	67	85	120
9	.....	1,770	1,360	1,120	405	154	65	87	85	125
10	.....	1,520	1,250	1,090	384	134	71	68	75	120

[a] Discharge measurement.

Daily discharge, in second-feet, of Minnesota River near Montevideo, Minn., for 1910— Continued.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11		1,990	1,290	1,030	415	154	55	50	79	117
12		2,060	1,200	964	410	149	49	71	75	112
13		2,250	1,130	954	478	130	52	68	73	111
14		2,100	1,090	902	452	119	59	67	87	110
15		2,010	1,100	770	410	131	61	68	68	119
16		2,340	1,260	832	367	123	62	69	83	125
17		2,420	1,310	889	355	114	83	59	79	128
18		2,260	1,320	851	334	106	78	75	77	122
19		2,210	1,310	822	288	89	75	71	90	117
20		2,180	1,360	864	271	92	88	72	119	114
21		2,180	1,490	832	271	100	84	73	90	125
22		2,150	1,620	832	256	101	85	65	89	122
23		2,100	1,780	822	250	87	94	75	90	120
24		2,080	1,670	841	242	82	85	79	95	123
25		2,030	1,650	792	241	109	99	77	97	126
26		1,990	1,630	751	220	86	98	88	103	142
27		1,820	1,600	688	206	84	96	100	119	130
28		1,850	1,580	656	199	58	65	83	138	130
29		1,730	1,540	599	190	67	71	78	123	130
30		1,690	1,510	659	184	74	57	74	97	130
31		1,680	.....	571	.....	78	83	.....	116	.....

NOTE.—Daily discharge computed from a well-defined rating curve, except from Mar. 1 to 5 and Nov. 28 to 30, which were estimated.

Monthly discharge of Minnesota River near Montevideo, Minn., for 1910.

[Drainage area, 6,300 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	*a* 200	0.032	0.04	C.
February	.....	.....	*a* 150	.024	.02	C.
March	2,420	150	1,690	.268	.31	B.
April	1,780	1,090	1,420	.225	.25	A.
May	1,410	571	946	.150	.17	A.
June	511	184	348	.055	.06	A.
July	184	58	121	.019	.02	A.
August	98	49	73.8	.012	.01	A.
September	100	50	72.5	.012	.01	A.
October	138	73	92.7	.015	.02	A.
November	142	86	119	.019	.02	B.
December	.....	.....	*a* 65	.010	.01	D.
The year	2,420	.....	442	.070	.94	

a Estimated.

MINNESOTA RIVER NEAR MANKATO, MINN.

This station, which is located at Sibley Park, 2 miles above the center of Mankato and a few hundred yards below the mouth of Blue Earth River, the nearest tributary, was established May 20, 1903.[1] Since 1906 the gage has been maintained by the United State Engineer Corps. The daily readings are taken by the United States Weather Bureau and furnished through the courtesy of that office.

[1] Gage heights for 1903 and 1904 have been published in Water-Supply Papers 99, p. 17, and 130, p. 53.

The nearest dam on the river is at Minnesota Falls, a short distance below Granite Falls, where 264 horsepower is developed under a head of 16 feet. There is no dam below the gaging station.

Discharge measurements are made from a boat and cable near the gage. Since the establishment of the station the datum of the gage has remained unchanged.

Ice is usually present at this station from December to March, and during that period the gage heights are taken through a hole in the ice. Therefore the open-water rating curve is not applicable. Owing to a lack of measurements, few winter estimates have been made.

Measurements made during the earlier years indicated changing conditions of flow, and accordingly the discharge for years previous to 1907 was obtained largely by the indirect method. These results can not be considered as accurate as the later ones which were based on a well-defined rating curve with fairly permanent conditions.

The estimates given herewith supersede those for 1905 and 1906, published in Water-Supply Papers 171, page 57, and 207, page 49.

The highest known stage of the river occurred in 1881 and is shown by a well-marked line in Mankato. The stage was approximately 27 feet above the zero of the present gage. This value was corroborated by Mr. M. B. Haynes, civil engineer of Mankato, who states that the high water occurred after the ice went out and was not caused by backwater. The corresponding discharge was approximately 65,000 second-feet. Since the establishment of the gage the highest stage recorded was 21.2 feet on June 26, 1908. The lowest stage recorded was during the summer of 1910, when the flow was about 165 second-feet.

Discharge measurements of Minnesota River near Mankato, Minn., in 1903–1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1903.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 20	E. Johnson, jr			9.20	7,630
June 23	W. R. Hoag			4.95	2,120
July 30	....do			5.11	3,010
Sept. 7	L. R. Stockman			5.15	3,260
Oct. 15	....do			10.45	12,300
Nov. 27	....do			3.30	1,280
1904.					
Jan. 17	E. Johnson, jr	365	1,130	2.30	580
Apr. 21	E. F. Chandler	302	2,000	6.48	4,910
June 28	....do	286	1,040	3.74	2,170
July 26	R. Richards	282	773	2.70	1,090
Aug. 31	....do	270	614	2.09	548
Oct. 18	E. F. Chandler	270	616	2.24	665
Dec. 30	R. Richards	220	498	[a] 2.20	315
1905.					
Apr. 3	R. Richards	295	1,400	5.08	3,280
May 10	E. F. Chandler	294	1,040	4.26	2,450
July 18	R. Richards	310	2,520	8.75	8,180
Sept. 12	....do	285	877	2.93	1,350
Nov. 1	E. F. Chandler	298	815	2.84	1,240
Dec. 29	R. Richards	297	811	[b] 3.85	1,070

[a] Gage height to water surface; thickness of ice, 0.6 foot.
[b] Gage height to water surface; thickness of ice, 0.8 foot.

Discharge measurements of Minnesota River near Mankato, Minn., in 1903–1910—Contd.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 11	A. H. Horton	310	1,890	7.59	6,020
May 24	M. S. Brennan	308	1,730	5.81	4,300
1909.					
Sept. 13	G. A. Gray	277	953	1.80	804
1910.					
Feb. 8	G. A. Gray	304	526	[a] 3.98	636
Mar. 15	C. J. Emerson	317	3,520	11.32	16,000
19	.....do	315	2,830	9.36	10,600
26	.....do	310	2,210	7.34	6,800
May 24	G. A. Gray	295	864	3.13	1,560
July 13	.....do	287	412	1.35	494
Oct. 29	C. J. Emerson	281	291	.98	253
Dec. 27	C. R. Adams	210	260	[b]	175

[a] Gage height to water surface; thickness of ice, 0.65 foot.
[b] Ice present. Gage height somewhat less than 0.8 foot, as water had receded from Weather Bureau gage.

Daily gage height, in feet, of Minnesota River near Mankato, Minn., for 1905–1910.

Day[a]	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.[a]												
1	2.0	2.0	4.05	5.2	2.95	6.05	6.35	5.4	3.35	2.95	2.9	4.15
2	1.9	2.0	4.25	5.25	2.95	5.9	7.65	5.25	3.3	2.9	2.8	8.2
3	1.9	2.0	4.5	5.1	3.0	5.75	7.95	5.15	3.25	2.85	2.85	7.95
4	1.95	2.0	5.5	5.05	3.35	5.6	8.95	4.95	3.2	2.8	2.8	7.55
5	1.95	2.0	5.7	5.2	3.9	5.45	9.55	4.8	3.15	2.8	2.9	7.45
6	1.9	2.0	6.1	5.25	4.0	5.3	10.75	4.65	3.1	2.7	3.25	7.65
7	1.9	2.0	5.9	5.25	3.95	5.15	11.85	4.6	3.0	2.7	3.35	7.45
8	1.9	2.0	5.5	5.2	3.8	4.9	12.35	4.45	3.0	2.7	3.55	7.15
9	1.9	2.0	5.3	5.1	3.75	4.8	12.65	4.35	2.95	2.65	3.65	6.85
10	1.9	2.0	4.8	4.9	4.2	4.7	12.15	4.25	2.9	2.8	3.65	6.25
11	1.9	2.0	4.2	4.7	5.15	4.6	11.95	4.15	2.9	2.7	3.65	6.15
12	2.0	2.1	4.1	4.5	6.1	4.55	11.35	4.0	2.9	2.65	3.65	6.05
13	2.0	2.15	4.4	4.35	6.4	4.4	11.85	3.85	2.85	2.6	3.6	5.95
14	2.0	2.15	3.6	4.2	7.1	4.35	10.35	3.85	2.8	2.65	3.6	5.65
15	2.0	2.2	3.8	4.1	8.1	4.2	9.95	3.85	2.9	2.85	3.55	5.5
16	2.0	2.2	3.95	3.9	9.3	4.25	9.45	3.85	2.85	2.9	3.5	5.25
17	2.0	2.2	4.0	3.9	9.9	4.4	9.15	3.65	2.9	2.9	3.4	5.1
18	2.0	2.2	4.1	3.8	10.1	4.3	8.85	3.85	2.9	2.95	3.4	5.0
19	2.0	2.2	5.4	3.7	10.0	4.4	8.55	3.85	4.6	2.85	3.35	4.75
20	2.0	2.2	5.9	3.6	9.9	4.35	8.25	3.75	3.9	2.95	3.35	4.65
21	2.0	2.1	6.3	3.5	9.7	4.3	7.95	3.7	3.65	2.95	3.3	4.6
22	2.0	2.1	6.5	3.35	9.3	4.15	7.75	3.65	3.6	3.0	3.25	4.55
23	2.0	2.4	6.8	3.3	8.9	4.1	7.45	3.55	3.5	3.05	3.2	4.25
24	2.0	2.5	6.8	3.3	8.3	4.05	7.15	4.0	3.4	3.05	3.55	4.0
25	2.0	3.1	6.7	3.2	7.9	4.85	6.95	3.85	3.2	3.0	3.75	4.05
26	2.0	3.6	6.5	3.2	7.5	5.7	6.75	3.7	3.1	3.0	3.9	4.05
27	2.0	3.8	6.2	3.1	7.5	6.2	6.45	3.65	3.1	2.95	3.95	4.0
28	2.0	4.5	6.1	3.05	6.7	6.3	6.15	3.65	3.05	2.95	5.2	3.95
29	2.0	.....	5.8	3.0	6.5	6.0	6.05	3.6	3.0	2.95	5.75	3.85
30	2.0	.....	5.6	2.95	6.3	5.9	5.75	3.55	2.95	2.95	4.55	3.75
31	2.0	.....	5.4	.....	6.15	.....	5.55	3.4	.....	2.9	.....	3.75

[a] These gage heights supersede those published in Water-Supply Paper 171, p. 57.

Daily gage height, in feet, of Minnesota River near Mankato, Minn., for 1905–1910—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906.[a]												
1	3.7	3.4	5.0	7.1	6.3	8.2	8.0	4.9	7.7	6.8	6.9	5.1
2	3.7	3.5	5.0	7.6	6.45	8.3	7.9	4.8	7.6	6.6	6.8	4.6
3	3.7	3.5	5.15	8.1	6.55	8.3	7.9	4.8	7.6	6.4	6.8	4.5
4	3.7	3.2	5.05	7.6	6.6	8.3	7.9	4.7	7.6	6.2	6.8	4.8
5	3.7	3.4	5.0	7.4	6.55	8.5	7.8	4.5	7.7	5.9	6.7	4.9
6	3.7	3.3	5.1	7.1	6.45	8.7	7.7	4.5	7.6	5.8	6.7	4.8
7	3.65	3.3	5.0	7.0	6.3	8.8	7.6	4.4	7.5	5.6	6.7	4.2
8	3.65	3.25	5.1	6.8	6.25	8.95	7.5	4.7	7.3	5.4	6.9	6.2
9	3.65	3.2	5.6	7.1	6.15	9.1	7.3	5.8	7.1	5.2	6.9	6.4
10	3.65	3.2	5.6	7.4	6.0	9.2	7.2	6.0	6.8	5.0	6.8	6.4
11	3.6	3.15	5.4	8.0	5.85	9.2	7.1	6.8	6.5	4.9	6.8	6.2
12	3.6	3.1	5.1	7.45	5.75	9.15	6.9	7.8	6.3	4.7	6.6	6.4
13	3.6	3.1	4.9	7.8	5.65	9.05	6.7	7.5	6.1	4.6	6.5	6.4
14	3.6	3.1	4.7	8.85	5.55	8.95	6.5	7.3	5.9	4.5	6.3	6.4
15	3.55	3.1	4.6	8.9	5.4	8.9	6.3	7.3	5.7	4.4	6.2	5.8
16	3.6	3.1	4.35	9.2	5.3	8.8	6.1	7.1	5.7	4.3	6.0	5.8
17	3.6	3.1	4.15	9.3	5.3	8.7	5.9	7.0	5.7	4.1	6.1	5.7
18	3.6	3.1	3.8	9.25	5.5	8.55	5.8	6.9	5.7	4.1	6.0	5.2
19	3.55	3.1	3.8	9.1	5.55	8.65	5.6	6.8	5.8	4.0	5.7	5.0
20	3.55	3.3	3.8	8.85	5.55	8.6	5.5	6.7	5.9	3.9	5.7	4.9
21	3.55	3.4	3.5	8.6	5.35	8.45	5.3	6.4	6.2	3.9	5.6	4.7
22	3.55	3.6	3.5	8.3	5.75	8.4	5.2	6.1	6.5	3.9	5.6	4.5
23	3.5	4.2	3.6	7.9	5.55	8.4	5.0	6.2	6.7	3.9	5.4	4.4
24	3.45	4.65	3.3	7.5	5.7	8.3	4.9	6.4	6.9	4.1	5.4	4.3
25	3.4	4.6	3.3	7.3	5.75	8.2	4.7	6.6	7.0	4.7	5.1	4.2
26	3.25	4.6	3.45	7.05	5.8	8.1	4.7	7.0	7.1	5.1	5.3	4.3
27	3.2	4.7	4.5	6.8	6.15	8.1	4.5	7.5	7.2	5.6	5.4	4.1
28	3.2	4.8	4.45	6.55	6.55	8.1	4.6	7.8	7.1	6.2	5.3	4.0
29	3.25	.....	4.85	6.45	7.0	8.1	4.8	8.0	7.1	6.5	5.2	4.0
30	3.4	.....	5.3	6.3	7.6	8.1	4.9	8.0	7.0	6.7	5.2	4.0
31	3.4	.....	5.65	.....	8.0	.....	5.0	7.9	.....	6.8	.....	4.0
1907.[b]												
1	4.0	3.2	6.2	9.0	5.9	7.1	11.2	6.2	5.7	3.6	2.6	2.8
2	4.0	3.1	6.0	9.3	5.9	7.0	10.5	5.8	5.4	3.6	3.0	2.7
3	4.0	3.1	5.8	10.1	5.9	6.8	10.2	5.5	5.1	3.9	3.4	2.6
4	3.9	3.2	5.6	10.5	6.0	6.5	9.8	5.2	4.8	3.7	3.6	2.5
5	3.9	3.2	5.4	10.8	6.1	6.4	9.5	5.1	4.6	3.8	3.6	2.4
6	3.9	3.2	5.4	10.7	6.0	6.2	9.2	4.9	4.2	4.0	3.6	2.4
7	3.9	3.2	5.4	10.5	6.0	6.2	8.8	4.8	4.1	4.0	3.4	2.4
8	3.8	3.3	5.3	10.3	6.0	6.2	8.4	4.6	4.0	3.9	3.4	2.5
9	3.8	3.3	5.2	10.0	5.9	6.4	8.1	4.6	3.9	3.7	3.3	2.6
10	3.8	3.3	5.1	9.7	5.8	8.7	7.7	4.6	3.7	3.6	3.2	2.6
11	3.7	3.2	4.9	9.3	5.7	10.0	7.4	4.4	3.7	3.3	3.2	2.3
12	3.7	3.2	4.9	9.1	5.5	11.3	6.9	4.3	3.6	3.2	3.1	2.6
13	3.7	3.2	4.9	8.8	5.5	12.2	6.4	4.2	3.4	3.1	2.9	2.6
14	3.6	3.3	4.9	8.5	5.4	12.5	6.3	4.0	3.3	3.1	2.7	2.6
15	3.6	3.4	4.9	8.3	5.3	12.5	7.0	3.9	3.3	3.0	2.7	2.6
16	3.6	3.7	5.7	8.1	5.4	12.4	7.2	3.8	3.2	3.0	2.6	2.7
17	3.6	4.2	6.5	8.0	5.5	12.2	7.3	3.7	3.4	2.9	2.8	2.7
18	3.6	5.3	7.1	7.8	5.5	13.1	7.5	3.6	3.6	2.9	2.9	2.7
19	3.6	5.8	7.4	7.4	5.5	13.5	7.9	3.6	4.0	2.8	2.9	2.7
20	3.6	6.5	8.2	7.2	5.5	14.0	7.8	4.4	4.3	2.8	2.9	2.5
21	3.5	7.3	8.1	7.1	5.5	14.1	8.2	4.7	5.6	2.7	2.8	2.5
22	3.5	7.3	9.1	6.8	5.4	14.1	8.8	4.6	6.0	2.7	2.8	2.3
23	3.5	7.3	9.3	6.5	5.3	13.7	8.9	4.4	5.6	2.7	2.8	2.5
24	3.5	7.0	8.8	6.3	5.2	13.6	8.9	4.2	5.1	2.7	2.8	2.5
25	3.5	6.8	8.5	6.2	5.4	13.7	8.8	4.0	4.7	2.6	2.8	2.5
26	3.4	6.6	8.7	6.1	6.0	13.8	8.5	3.8	4.4	2.6	2.8	2.5
27	3.4	6.4	8.7	6.0	6.5	13.4	7.8	4.4	4.2	2.6	2.8	2.3
28	3.3	6.3	8.7	6.0	7.1	12.9	7.7	5.3	3.9	2.6	2.8	2.2
29	3.3	.....	8.8	5.9	7.2	12.4	7.3	5.7	3.8	2.6	2.8	2.2
30	3.2	.....	8.8	5.9	7.3	11.8	7.0	5.8	3.7	2.6	2.8	2.2
31	3.2	.....	8.9	.....	7.2	.....	6.6	5.7	.....	2.6	.....	2.5

[a] These gage heights supersede those published in Water-Supply Paper No. 207, p. 49.

[b] The following corrections have been made to the United States Weather Bureau gage heights, owing to change in gage datum: Jan. 1–Feb. 28 +0.4; Mar. 1–Aug. 9 +0.5; Aug. 10–Dec. 31 +0.6.

Daily gage height, in feet, of Minnesota River near Mankato, Minn., for 1905–1910—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.[a]												
1	2.8	2.4	3.6	5.3	6.9	17.2	17.0	7.7	3.5	2.4	3.0	3.3
2	3.0	2.4	3.6	5.2	6.7	16.6	16.5	7.4	3.3	2.4	3.0	3.0
3	2.9	2.4	3.6	5.1	6.6	15.8	15.8	7.1	3.2	2.5	2.9	2.8
4	2.9	2.4	3.6	5.2	6.3	14.6	15.0	6.9	3.1	2.5	2.9	3.0
5	2.9	2.4	3.4	5.2	6.5	14.1	14.4	6.5	3.1	2.5	2.9	2.9
6	2.2	2.4	3.3	5.1	5.9	13.7	14.5	6.1	3.0	2.5	2.8	2.9
7	2.4	2.4	3.3	5.2	5.7	13.5	14.5	5.9	2.9	2.5	2.8	2.9
8	2.6	2.4	3.2	5.2	5.7	13.3	14.2	5.7	2.8	2.5	2.7	2.9
9	2.6	2.4	3.2	5.2	5.7	12.8	14.0	5.5	2.8	2.5	2.6	2.9
10	2.6	2.4	3.2	5.1	5.7	12.6	13.8	5.5	2.7	2.5	2.5	2.9
11	2.6	2.5	4.0	5.1	5.5	12.2	13.3	5.0	2.6	2.4	2.4	2.9
12	2.6	2.6	5.4	5.0	5.5	11.9	12.6	4.9	2.6	2.4	2.3	2.8
13	2.6	2.8	4.3	5.2	5.3	11.7	12.3	4.8	2.5	2.4	2.3	2.7
14	2.6	3.2	4.3	5.2	5.4	11.3	11.9	4.6	2.5	2.4	2.3	2.7
15	2.6	3.2	5.2	5.0	6.3	10.9	11.5	4.5	2.5	2.4	2.3	2.7
16	2.6	3.4	5.8	5.0	7.1	10.6	11.1	4.5	2.5	2.4	2.3	2.7
17	2.6	3.4	6.0	5.0	7.6	10.2	11.0	4.4	2.5	2.3	2.3	2.7
18	2.4	3.4	5.7	5.1	8.2	10.1	11.1	4.3	2.5	2.3	2.3	2.7
19	2.4	3.4	5.6	5.5	8.7	10.3	11.4	4.3	2.5	2.3	2.3	2.7
20	2.4	3.4	5.4	5.7	9.0	10.3	11.3	4.2	2.4	2.3	2.3	2.7
21	2.4	3.8	5.6	5.7	10.1	11.9	10.8	4.1	2.4	2.4	2.3	2.7
22	2.4	3.7	5.5	5.6	11.8	12.1	10.3	4.0	2.4	2.4	2.3	2.7
23	2.4	3.7	5.4	5.4	12.6	16.0	9.7	3.9	2.4	2.4	2.3	2.7
24	2.4	3.7	5.5	5.3	12.4	18.4	9.0	3.8	2.4	2.5	2.5	2.7
25	2.4	3.7	5.4	5.4	12.8	21.0	8.4	3.7	2.4	2.5	2.7	2.7
26	2.4	3.6	5.3	5.8	13.0	21.2	7.8	3.6	2.4	2.6	2.8	2.7
27	2.4	3.6	5.3	6.0	13.2	20.5	8.7	3.5	2.3	2.7	2.9	2.6
28	2.4	3.6	5.3	6.6	14.0	19.6	8.8	3.6	2.3	2.7	2.9	2.6
29	2.4	3.6	5.3	6.9	15.0	18.9	9.0	3.8	2.3	2.7	2.9	2.5
30	2.4	.....	5.2	6.9	17.2	17.8	8.7	3.8	2.4	2.8	3.1	2.5
31	2.4	.....	5.1	.....	17.5	.....	8.0	3.7	.....	2.9	.....	2.5
1909.[b]												
1	2.6	4.1	3.1	16.8	7.9	7.6	10.9	3.0	2.2	1.8	1.6	7.0
2	2.6	4.1	3.1	16.4	8.3	8.0	10.9	2.8	2.1	1.8	1.7	7.0
3	2.6	4.1	3.2	15.9	8.2	8.5	10.9	2.7	2.1	1.7	1.7	7.1
4	2.6	4.1	3.2	15.5	8.2	8.7	10.7	2.6	2.1	1.6	1.7	7.1
5	2.6	4.3	3.2	15.1	8.1	8.8	10.3	2.5	2.0	1.6	3.5	7.1
6	2.6	4.1	3.3	14.8	7.9	8.9	9.8	2.4	2.0	1.5	3.5	6.1
7	2.6	3.9	3.3	14.5	7.6	8.7	9.4	2.3	1.9	1.5	3.3	6.7
8	2.6	3.7	3.3	13.9	7.3	8.5	9.0	2.3	1.9	1.4	3.1	7.1
9	2.6	3.5	3.3	13.3	6.9	8.3	8.4	2.3	1.9	1.4	2.9	7.1
10	2.6	3.4	3.5	12.8	6.5	8.1	8.0	2.3	1.9	1.5	2.7	7.1
11	2.6	3.3	5.3	12.2	6.1	7.9	7.6	2.2	1.9	1.6	2.5	7.1
12	2.6	3.1	7.1	12.0	5.8	7.8	7.2	2.5	1.9	1.6	2.5	7.1
13	2.6	3.0	7.1	11.9	5.6	8.0	6.7	2.7	1.9	1.6	2.5	7.1
14	2.6	3.0	7.3	11.7	5.3	8.3	6.5	3.1	1.9	1.7	3.1	7.1
15	2.6	3.0	7.5	11.5	5.2	8.4	6.1	3.9	1.9	1.8	3.7	7.0
16	2.6	3.0	7.7	11.1	5.2	8.1	5.9	4.3	1.9	1.8	4.7	7.0
17	2.6	3.0	7.7	10.8	5.2	8.3	5.6	4.7	1.8	1.8	4.9	6.9
18	2.6	3.0	7.8	10.3	5.3	8.1	5.3	4.6	1.8	1.8	4.6	6.7
19	2.6	3.0	7.9	10.1	5.5	8.0	5.4	4.3	1.8	1.8	4.7	6.5
20	2.6	3.0	8.1	9.9	5.5	7.8	5.5	4.1	1.7	1.7	4.8	6.3
21	2.6	3.0	8.2	9.6	5.5	7.5	5.3	4.0	1.7	1.7	4.8	6.1
22	2.6	3.1	8.3	9.4	5.5	7.1	4.2	3.7	1.9	1.7	4.8	5.9
23	2.9	3.1	8.5	9.2	5.3	7.0	4.6	3.5	1.9	1.7	4.8	5.7
24	3.1	3.1	9.5	9.0	5.2	7.5	4.3	3.2	1.9	1.7	4.9	5.5
25	3.1	3.1	11.7	8.8	5.2	7.6	4.1	3.1	2.0	1.7	4.9	5.3
26	3.1	3.1	12.7	8.6	5.3	7.3	3.9	3.0	2.1	1.7	4.9	5.1
27	3.0	3.1	13.6	8.2	6.7	8.1	3.5	2.8	2.0	1.6	5.3	5.0
28	3.0	3.1	16.3	8.1	6.0	9.0	3.5	2.7	2.0	1.6	5.6	5.0
29	4.3	.....	17.3	7.8	6.5	10.1	3.4	2.5	2.0	1.6	6.7	5.0
30	4.2	.....	17.3	7.9	6.8	10.6	3.2	2.5	1.9	1.6	6.9	4.9
31	4.1	.....	17.1	.....	7.2	.....	3.1	2.3	.....	1.6	.....	4.8

[a] The following correction has been applied to the United States Weather Bureau gage heights, owing to change in gage datum: Jan. 1–17 +0.6.

[b] The following correction has been made to the United States Weather Bureau gage heights, owing to change in gage datum, Jan. 1–Dec. 31, +0.1.

Daily gage height, in feet, of Minnesota River near Mankato, Minn., for 1905–1910—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910.[a]												
1	4.8	4.2	3.7	5.4	4.6	3.0	2.0	1.0	0.9	1.0	1.0	1.0
2	4.7	4.1	3.7	5.3	4.4	2.9	1.9	1.0	.9	.9	1.0	1.0
3	4.7	4.1	3.8	5.2	4.2	2.9	1.9	1.0	.9	.9	1.0	1.0
4	4.7	4.0	3.9	5.0	4.0	2.8	1.8	1.0	1.0	.9	1.0	1.0
5	4.7	4.0	4.0	4.8	3.8	2.7	1.8	1.0	1.0	1.0	1.1	1.0
6	4.6	4.0	5.6	4.6	3.7	2.7	1.7	.9	.9	.9	1.1	1.0
7	4.6	4.0	8.1	4.6	3.7	2.6	1.7	.9	.9	.9	1.1	.9
8	4.6	4.0	8.5	4.6	3.6	2.6	1.6	.9	.9	.9	1.1	.9
9	4.5	4.0	9.2	4.6	3.6	2.6	1.6	.8	.9	.9	1.1	.9
10	4.5	4.0	11.0	4.5	3.6	2.5	1.6	.8	.9	.9	1.1	.9
11	4.4	4.0	12.2	4.5	3.6	2.5	1.5	.8	.8	.9	1.1	.9
12	4.4	4.0	14.85	4.5	3.6	2.4	1.5	.8	.8	.9	1.1	.9
13	4.4	4.0	13.1	4.4	3.6	2.5	1.5	.8	.8	.9	1.1	.9
14	4.4	4.0	12.1	4.2	3.6	2.4	1.4	.8	.8	.9	1.1	.9
15	4.3	3.9	11.4	4.0	3.6	2.3	1.3	.8	.8	.9	1.1	.9
16	4.3	3.9	11.0	4.0	3.6	2.3	1.3	.8	.9	.9	1.1	.9
17	4.3	3.8	11.4	4.0	3.6	2.2	1.3	1.0	.9	.9	1.0	.9
18	4.3	3.8	9.9	3.9	3.6	2.4	1.2	1.0	.9	.9	1.0	.....
19	4.2	3.8	9.4	3.9	3.5	2.4	1.2	1.0	.9	.9	1.0	.....
20	4.2	3.8	9.1	3.9	3.4	2.2	1.2	1.3	.9	.9	1.0	.....
21	4.2	3.8	8.8	3.9	3.4	2.2	1.1	1.4	.9	.9	1.0	.....
22	4.2	3.8	8.5	3.9	3.4	2.2	1.1	1.2	.9	.9	1.0	.....
23	4.2	3.7	8.4	3.9	3.3	2.2	1.1	1.0	.9	.9	1.0	.....
24	4.2	3.7	7.9	3.9	3.3	2.1	1.1	1.0	.9	1.0	1.0	.....
25	4.2	3.7	7.7	3.9	3.2	2.1	1.1	1.0	.9	1.0	1.0	.....
26	4.2	3.7	7.4	4.1	3.2	2.0	1.0	1.0	1.0	1.0	1.0	.....
27	4.2	3.7	7.1	4.3	3.1	1.0	1.0	1.0	1.0	1.0	1.0	.....
28	4.2	3.7	6.8	4.4	3.1	2.0	1.0	1.0	1.0	1.0	1.0	.....
29	4.2	3.7	6.4	4.6	3.1	2.0	1.0	1.0	1.0	1.0	1.0	.....
30	4.2	.....	6.2	4.8	3.0	2.0	1.0	.9	1.0	1.0	1.0	.....
31	4.2	.....	6.0	.....	3.0	.....	1.0	.9	.....	1.0	.....	.....

[a] The following correction has been made to the United States Weather Bureau gage heights, owing to change in gage datum, Jan. 1–Mar. 7, +0.10, Sept. 16–Dec. 31, +0.10. Ice conditions from Jan. 1 to Mar. 14, and from Dec. 1 to 31.

Daily discharge, in second-feet, of Minnesota River near Mankato, Minn., for 1903–1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.[a]												
1	.....	.....	.....	.....	.....	27,200	3,710	3,100	2,980	5,760	3,650	1,340
2	.....	.....	.....	.....	.....	23,000	3,900	2,930	3,770	5,610	3,460	1,260
3	.....	.....	.....	.....	.....	18,900	4,350	2,880	3,460	5,460	3,340	1,220
4	.....	.....	.....	.....	.....	15,800	6,960	2,980	4,090	6,060	3,220	1,260
5	.....	.....	.....	.....	.....	13,400	6,540	3,400	4,160	6,140	3,100	1,260
6	.....	.....	.....	.....	.....	11,300	6,620	3,840	4,160	6,460	2,980	1,300
7	.....	.....	.....	.....	.....	9,530	6,540	4,090	2,980	15,600	2,760	1,300
8	.....	.....	.....	.....	.....	7,380	6,460	3,840	3,460	18,900	2,660	1,300
9	.....	.....	.....	.....	.....	6,700	6,300	3,340	3,580	20,500	2,540	1,300
10	.....	.....	.....	.....	.....	6,700	6,380	3,100	3,840	20,400	2,490	1,300
11	.....	.....	.....	.....	.....	5,910	6,300	2,880	4,220	18,600	2,440	1,300
12	.....	.....	.....	.....	.....	5,460	5,760	2,760	5,610	17,200	2,390	1,260
13	.....	.....	.....	.....	.....	5,180	5,460	2,660	8,120	15,500	2,340	1,260
14	.....	.....	.....	.....	.....	4,760	5,320	2,660	13,500	13,900	2,280	1,220
15	.....	.....	.....	.....	.....	4,480	4,760	3,960	17,800	12,200	2,230	1,190
16	.....	.....	.....	.....	.....	3,960	4,220	4,350	22,700	10,800	1,930	1,190
17	.....	.....	.....	.....	.....	3,710	4,160	5,460	27,300	10,100	1,380	1,190
18	.....	.....	.....	.....	.....	3,220	4,690	5,180	25,100	9,110	1,220	1,160
19	.....	.....	.....	.....	.....	3,100	4,960	4,760	22,600	8,310	1,090	1,160
20	.....	.....	.....	.....	9,530	2,930	5,460	4,220	19,500	7,930	1,030	1,160
21	.....	.....	.....	.....	8,500	2,930	6,060	4,090	17,200	7,380	970	1,160
22	.....	.....	.....	.....	7,650	2,880	5,610	3,960	14,800	6,790	1,000	1,160
23	.....	.....	.....	.....	7,560	2,880	5,540	3,460	13,200	6,220	1,000	1,160
24	.....	.....	.....	.....	7,650	2,760	5,040	3,100	11,300	5,910	1,100	1,160
25	.....	.....	.....	.....	10,800	2,710	4,690	2,880	10,100	5,320	1,100	1,160
26	.....	.....	.....	.....	14,900	2,540	4,220	2,660	8,800	5,040	1,200	1,160
27	.....	.....	.....	.....	22,300	2,540	4,090	2,540	8,220	4,760	1,300	1,160
28	.....	.....	.....	.....	30,800	2,490	4,220	2,490	6,700	4,480	1,300	1,160
29	.....	.....	.....	.....	38,700	2,440	3,710	2,930	5,610	4,220	1,260	1,160
30	.....	.....	.....	.....	36,800	2,540	3,460	2,930	6,140	3,960	1,380	1,160
31	.....	.....	.....	.....	32,000	.....	2,980	2,930	.....	3,770	.....	1,000

[a] Daily discharge computed from a fairly well-defined rating curve. The gage heights were published in Water-Supply Paper 99, p. 17.

Daily discharge, in second-feet, of Minnesota River near Mankato, Minn., for 1903–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904. [a]												
1	1,160	.....	.....	3,220	4,760	1,420	1,940	1,120	550	470	870	600
2	1,160	.....	.....	3,100	4,420	1,460	1,820	1,090	750	470	840	.....
3	1,160	.....	.....	2,930	4,220	1,700	1,780	1,000	910	470	840	.....
4	1,030	.....	.....	2,880	3,960	1,930	1,730	930	750	470	840	.....
5	980	.....	.....	2,880	3,710	2,910	1,700	900	750	470	810	.....
6	860	.....	.....	2,760	3,770	3,040	1,640	840	720	470	810	.....
7	740	.....	.....	2,660	3,840	2,350	1,520	810	690	470	810	.....
8	680	.....	.....	2,540	3,710	2,350	1,490	810	690	470	780	.....
9	660	.....	.....	3,710	3,580	2,400	1,430	910	690	470	780	.....
10	640	.....	.....	5,180	3,460	2,400	1,520	940	630	530	780	.....
11	630	.....	.....	6,540	3,340	2,480	1,520	890	630	580	750	.....
12	630	.....	.....	7,740	3,100	2,430	1,400	820	630	580	750	.....
13	620	.....	.....	7,740	2,980	2,370	1,400	820	605	580	750	.....
14	620	.....	.....	7,380	2,880	2,320	1,400	760	580	580	750	.....
15	600	.....	.....	6,960	2,660	2,260	1,320	760	580	580	750	.....
16	590	.....	.....	6,540	2,540	2,070	1,240	720	580	580	750	.....
17	580	.....	.....	6,220	2,440	1,970	1,140	720	580	580	690	.....
18	580	.....	.....	5,760	2,280	1,970	1,140	700	530	665	690	.....
19	580	.....	.....	5,460	2,130	1,920	1,140	700	530	720	690	.....
20	580	.....	.....	5,180	2,080	1,920	1,060	670	530	870	690	.....
21	580	.....	.....	4,900	2,030	1,880	1,060	650	510	940	690	.....
22	580	.....	.....	5,180	1,930	1,830	980	650	510	1,010	690	.....
23	570	.....	.....	5,760	1,880	1,840	950	620	490	1,050	690	.....
24	570	.....	.....	6,220	1,840	1,790	950	600	490	1,010	690	.....
25	570	.....	.....	6,220	1,740	1,820	950	600	470	1,010	655	.....
26	560	.....	.....	6,060	1,740	2,120	1,090	540	470	975	655	.....
27	560	.....	.....	6,060	1,640	2,220	1,050	540	470	940	625	.....
28	560	.....	.....	5,760	1,600	2,170	1,020	540	470	940	625	.....
29	560	.....	.....	5,320	1,560	2,130	1,020	540	470	940	625	.....
30	560	.....	.....	5,100	1,510	2,020	1,120	540	470	940	625	315
31	560	.....	.....	.....	1,460	.....	1,160	540	.....	905	.....	.....
1905. [b]												
1	.....	.....	2,160	3,460	1,180	4,550	4,960	3,460	1,690	1,340	1,300	.....
2	.....	.....	2,370	3,520	1,180	4,340	6,950	3,280	1,640	1,300	1,220	.....
3	.....	.....	2,640	3,340	1,220	4,150	7,460	3,160	1,610	1,260	1,260	.....
4	.....	.....	3,830	3,280	1,510	3,960	9,400	2,930	1,560	1,220	1,220	.....
5	.....	.....	4,080	3,460	2,010	3,770	10,700	2,760	1,510	1,220	1,300	.....
6	.....	.....	4,620	3,520	2,110	3,580	13,500	2,600	1,470	1,140	1,590	.....
7	.....	.....	4,340	3,520	2,060	3,400	16,400	2,540	1,400	1,140	1,680	.....
8	.....	.....	3,830	3,460	1,920	3,100	17,700	2,390	1,400	1,140	1,860	.....
9	.....	.....	3,580	3,340	1,870	2,980	18,600	2,280	1,370	1,100	1,950	.....
10	.....	.....	2,980	3,100	2,320	2,860	17,100	2,180	1,340	1,220	1,950	.....
11	.....	.....	2,320	2,860	3,400	2,750	16,600	2,100	1,340	1,140	1,950	.....
12	.....	.....	2,210	2,640	4,620	2,700	14,900	2,050	1,340	1,100	1,950	.....
13	.....	.....	2,530	2,480	5,040	2,530	16,300	1,960	1,260	1,060	1,900	.....
14	.....	.....	1,730	2,320	6,090	2,480	12,200	1,960	1,220	1,100	1,900	.....
15	.....	.....	1,920	2,210	7,730	2,320	11,100	1,960	1,300	1,260	1,860	.....
16	.....	.....	2,060	2,010	10,100	2,370	9,900	1,960	1,260	1,300	1,810	.....
17	.....	.....	2,110	2,010	11,500	2,530	9,150	1,380	1,300	1,300	1,720	.....
18	.....	.....	2,210	1,920	11,900	2,420	8,180	1,960	1,300	1,340	1,720	.....
19	.....	.....	3,700	1,820	11,700	2,530	7,820	1,960	2,930	1,260	1,680	.....
20	.....	.....	4,340	1,730	11,500	2,480	7,270	1,870	2,200	1,340	1,680	.....
21	.....	.....	4,900	1,640	11,000	2,420	6,760	1,820	1,950	1,340	1,630	.....
22	.....	.....	5,180	1,510	10,100	2,260	6,450	1,380	1,900	1,380	1,590	.....
23	.....	.....	5,620	1,460	9,290	2,210	5,960	1,680	1,810	1,420	1,540	.....
24	.....	.....	5,620	1,460	8,110	2,160	5,540	2,260	1,720	1,420	1,860	.....
25	.....	.....	5,480	1,380	7,380	3,040	5,400	2,120	1,540	1,380	1,500	.....
26	.....	.....	5,180	1,380	6,710	4,080	5,120	1,940	1,460	1,380	1,500	.....
27	.....	.....	4,760	1,300	6,710	4,760	4,720	1,890	1,460	1,340	1,500	.....
28	.....	.....	4,620	1,260	5,480	4,900	4,340	1,890	1,420	1,340	1,500	.....
29	.....	.....	4,220	1,220	5,180	4,480	4,210	1,850	1,380	1,340	1,500	1,070
30	.....	.....	3,960	1,180	4,900	4,340	3,850	1,800	1,340	1,340	1,500	.....
31	.....	.....	3,700	.....	4,680	.....	3,650	1,730	.....	1,300	.....	.....

[a] Daily discharge computed by means of an indirect application of the rating table, owing to changing conditions. The gage heights have been published in Water-Supply Paper 130, p. 53.

[b] Daily discharge computed from a fairly well-defined rating curve, which is applied indirectly after July 9.

Daily discharge, in second-feet, of Minnesota River near Mankato, Minn., for 1903–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906.[a]												
1				5,300	4,580	7,960	7,600	3,260	7,090	5,700	5,840	3,490
2				6,050	4,770	8,140	7,430	3,150	6,930	5,420	5,700	2,930
3				6,830	4,970	8,140	7,430	3,150	6,930	5,140	5,700	2,820
4				6,050	5,050	8,140	7,430	3,040	6,930	4,860	5,700	3,150
5				5,730	4,970	8,520	7,260	2,820	7,090	4,470	5,560	3,260
6				5,300	4,900	8,910	7,090	2,820	6,930	4,340	5,560	3,150
7				5,150	4,680	9,110	6,930	2,720	6,770	4,090	5,560	2,500
8				5,870	4,610	9,420	6,770	3,040	6,460	3,840	5,840	.....
9				5,300	4,510	9,730	6,460	4,340	6,140	3,600	5,840	.....
10				5,740	4,320	9,940	6,300	4,600	5,700	3,380	5,700	.....
11				6,690	4,120	9,940	6,140	5,700	5,280	3,260	5,700	.....
12				5,900	4,050	9,840	5,840	7,260	5,000	3,040	5,420	.....
13				6,450	3,910	9,620	5,560	6,770	4,730	2,930	5,280	.....
14				8 340	3,800	9,420	5,280	6,460	4,470	2,820	5,000	.....
15				8,510	3,680	9,310	5,000	6,460	4,220	2,720	4,860	.....
16				9,100	3,550	9,110	4,730	6,140	4,220	2,610	4,600	.....
17				9,290	3,550	8,910	4,470	6,000	4,220	2,400	4,730	.....
18				9,210	3,860	8,620	4,340	5,840	4,220	2,400	4,600	.....
19				8,990	3,910	8,810	4,090	5,700	4,340	2,300	4,220	.....
20				8,520	3,910	8,710	3,960	5,560	4,470	2,200	4,220	.....
21				8,120	3,780	8,420	3,720	5,140	4,860	2,200	4,090	.....
22				7,540	4,280	8,330	3,600	4,730	5,280	2,200	4,090	.....
23				6,840	4,030	8,330	3,380	4,860	5,560	2,200	3,840	.....
24				6,080	4,220	8,140	3,260	5,140	5,840	2,400	3,840	.....
25				5,940	4,280	7,960	3,040	5,420	6,000	3,040	3,490	.....
26				5,550	4,340	7,780	3,040	6,000	6,140	3,490	3,720	.....
27				5,230	4,810	7,780	2,820	6,770	6,300	4,090	3,840	.....
28				4,860	5,340	7,780	2,930	7,260	6,140	4,860	3,720	.....
29				4,720	6,000	7,780	3,150	7,600	6,140	5,280	3,600	.....
30				4,580	6,930	7,780	3,260	7,600	6,000	5,560	3,600	.....
31				.....	7,600	.....	3,380	7,430	.....	5,700	.....	.....
1907.[a]												
1				9,520	4,470	6,140	14,600	4,860	4,220	1,900	1,060	.....
2				10,200	4,470	6,000	12,900	4,340	3,840	1,900	1,380	.....
3				12,000	4,470	5,700	12,200	3,960	3,490	2,200	1,720	.....
4				12,900	4,600	5,280	11,300	3,600	3,150	2,000	1,900	.....
5				13,600	4,730	5,140	10,600	3,490	2,930	2,100	1,900	.....
6				13,400	4,600	4,860	9,940	3,260	2,500	2,300	1,900	.....
7				12,900	4,600	4,860	9,110	3,150	2,400	2,300	1,720	.....
8				12,400	4,600	4,860	8,330	2,930	2,300	2,200	1,720	.....
9				11,700	4,470	5,140	7,780	2,930	2,200	2,000	1,630	.....
10				11,000	4,340	8,910	7,090	2,930	2,000	1,900	1,540	.....
11				10,200	4,220	11,700	6,610	2,720	2,000	1,630	1,540	.....
12				9,730	3,960	14,800	5,840	2,610	1,900	1,540	1,460	.....
13				9,110	3,960	17,100	5,140	2,500	1,720	1,460	1,300	.....
14				8,520	3,840	17,800	5,000	2,300	1,630	1,460	1,140	.....
15				8,140	3,720	17,800	6,000	2,200	1,630	1,380	1,140	.....
16				7,780	3,840	17,600	6,300	2,100	1,540	1,380	1,060	.....
17				7,600	3,960	17,100	6,460	2,000	1,720	1,300	1,220	.....
18				7,260	3,960	19,400	6,770	1,900	1,900	1,300	1,300	.....
19				6,610	3,960	20,400	7,430	1,900	2,300	1,220	1,300	.....
20				6,300	3,960	21,800	7,260	2,720	2,610	1,220	1,300	.....
21			7,780	6,140	3,960	22,100	7,960	3,040	4,090	1,140	1,220	.....
22			9,730	5,700	3,840	22,100	9,110	2,930	4,600	1,140	1,220	.....
23			10,260	5,280	3,720	21,000	9,310	2,720	4,090	1,140	1,220	.....
24			9,110	5,000	3,600	20,700	9,310	2,500	3,490	1,140	1,220	.....
25			8,520	4,860	3,840	21,000	9,110	2,300	3,040	1,060	1,220	.....
26			8,910	4,730	4,600	21,300	8,520	2,100	2,720	1,060	1,220	.....
27			8,910	4,600	5,280	20,200	7,260	2,720	2,500	1,060	1,220	.....
28			8,910	4,600	6,140	18,900	7,090	3,720	2,200	1,060	1,220	.....
29			9,110	4,470	6,300	17,600	6,460	4,220	2,100	1,060	1,220	.....
30			9,110	4,470	6,460	16,100	6,000	4,340	2,000	1,060	1,220	.....
31			9,310	.....	6,300	.....	5,420	4,220	.....	1,060	.....	.....

[a] Daily discharge computed from a fairly well-defined rating curve, which is applied indirectly prior to May 20, 1906.

Daily discharge, in second-feet, of Minnesota River near Mankato, Minn., for 1903–1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.[a]												
1				3,720	5,840	31,100	30,500	7,090	1,810	911	1,380	
2				3,600	5,560	29,300	29,000	6,610	1,630	911	1,380	
3				3,460	5,420	26,900	26,900	6,140	1,540	987	1,300	
4				3,600	5,000	23,500	24,600	5,810	1,460	987	1,300	
5				3,600	5,280	22,100	22,900	5,280	1,460	987	1,300	
6				3,490	4,470	21,000	23,200	4,730	1,380	987	1,220	
7				3,600	4,220	20,400	23,200	4,470	1,300	987	1,220	
8				3,600	4,220	19,900	22,400	4,220	1,220	987	1,140	
9				3,600	4,220	18,600	21,800	3,960	1,220	987	1,060	
10				3,490	4,220	18,100	21,300	3,960	1,140	987	987	
11				3,490	3,960	17,100	19,900	3,380	1,060	911	911	
12				3,380	3,960	16,400	18,100	3,260	1,060	911	835	
13				3,600	3,720	15,800	17,400	3,150	987	911	835	
14				3,600	3,840	14,800	16,400	2,930	987	911	835	
15				3,380	5,000	13,900	15,400	2,820	987	911	835	
16			4,340	3,380	6,140	13,100	14,400	2,820	987	911	835	
17			4,600	3,380	6,930	12,200	14,100	2,720	987	835	835	
18			4,220	3,490	7,960	12,000	14,400	2,610	987	835	835	
19			4,090	3,960	8,910	12,400	15,100	2,610	987	835	835	
20			3,840	4,200	9,520	12,400	14,800	2,500	911	835	835	
21			4,090	4,200	12,000	16,400	13,600	2,400	911	911	835	
22			3,960	4,090	16,100	16,800	12,400	2,300	911	911	835	
23			3,840	3,840	18,100	27,500	11,000	2,200	911	911	835	
24			3,960	3,720	17,600	34,900	9,520	2,100	911	987	835	
25			3,840	3,840	18,600	43,200	8,330	2,000	911	987	835	
26			3,720	4,340	19,200	43,800	7,260	1,900	911	1,060	835	
27			3,720	4,600	19,700	41,600	8,910	1,810	835	1,140	835	
28			3,720	5,420	21,800	38,700	9,110	1,900	835	1,140	835	
29			3,720	5,840	24,600	36,500	9,520	2,100	835	1,140	835	
30			3,600	5,840	31,100	33,000	8,910	2,100	911	1,220	835	
31			3,490		32,000		7,600	2,000		1,300		
1909.[b]												
1				29,900	7,600	7,070	14,000	1,440	925	695	585	
2				28,700	8,340	7,780	14,000	1,300	865	695	640	
3				27,200	8,150	8,720	14,000	1,240	865	640	640	
4				26,000	8,150	9,120	13,500	1,170	865	585	640	
5				24,900	7,960	9,320	12,600	1,100	805	585	1,820	
6				24,000	7,600	9,520	11,500	1,040	805	530	1,820	
7				23,200	7,070	9,120	10,600	985	750	530	1,660	
8				21,500	6,560	8,720	9,730	985	750	475	1,520	
9				19,900	5,920	8,340	8,530	985	750	475	1,370	
10				18,600	5,310	7,960	7,780	985	750	530	1,240	
11				17,100	4,730	7,600	7,070	925	750	585	1,100	
12				16,600	4,310	7,420	6,400	1,100	750	585	1,100	
13				16,400	4,040	7,780	5,610	1,240	750	585	1,100	
14				15,900	3,650	8,340	5,310	1,520	750	640	1,520	
15				15,400	3,520	8,530	4,730	1,370	750	695	2,000	
16			7,240	14,400	3,520	7,960	4,450	2,540	750	695	2,950	
17			7,240	13,700	3,520	8,340	4,040	2,950	695	695	3,170	
18			7,420	12,600	3,650	7,960	3,650	2,840	695	695	2,840	
19			7,600	12,100	3,900	7,780	3,780	2,540	695	695	2,950	
20			7,960	11,700	3,900	7,420	3,900	2,350	640	640	3,060	
21			8,150	11,000	3,900	6,900	3,650	2,260	640	640	3,060	
22			8,340	10,600	3,900	6,240	2,440	2,000	750	640	3,060	
23			8,720	10,200	3,650	6,080	2,840	1,820	750	640	3,060	
24			10,800	9,730	3,520	6,900	2,540	1,590	750	640	3,170	
25			15,900	9,320	3,520	7,070	2,350	1,520	805	640	3,170	
26			18,400	8,920	3,650	6,560	2,170	1,440	865	640	3,170	
27			20,700	8,150	5,610	7,960	1,820	1,300	805	585	3,650	
28			28,400	7,960	4,590	9,730	1,820	1,240	805	585	4,040	
29			31,400	7,420	5,310	12,100	1,740	1,100	805	585	5,610	
30			31,400	7,600	5,760	13,300	1,590	1,100	750	585	5,920	
31			30,800		6,400		1,520	985		585		

[a] These discharges are based on a fairly well defined rating curve.

[b] Daily discharge computed from a fairly well defined rating curve. The estimates have been revised since they were published in "Report of Water Resources Investigation of Minnesota during 1909–10."

Daily discharge, in second-feet, of Minnesota River near Mankato, Minn., for 1903–1910— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910.[a]												
1			500	3,780	2,840	1,440	805	265	215	265	265	
2			500	3,650	2,640	1,370	750	265	215	215	265	
3			600	3,520	2,440	1,370	750	265	215	215	265	
4			600	3,280	2,260	1,300	695	265	265	215	265	
5			700	3,060	2,080	1,240	695	265	265	265	315	
6			1,500	2,840	2,000	1,240	640	215	215	215	315	
7			4,000	2,840	2,000	1,170	640	215	215	215	315	
8			4,500	2,840	1,910	1,170	585	215	215	215	315	
9			5,000	2,840	1,910	1,170	585	165	215	215	315	
10			7,000	2,740	1,910	1,100	585	165	215	215	315	
11			10,000	2,740	1,910	1,100	530	165	165	215	315	
12			20,000	2,740	1,910	1,040	530	165	165	215	315	
13			18,000	2,640	1,910	1,100	530	165	165	215	315	
14			16,000	2,440	1,910	1,040	475	165	165	215	315	
15			15,200	2,260	1,910	985	420	165	165	215	315	
16			14,200	2,260	1,910	985	420	165	215	215	315	
17			15,200	2,260	1,910	925	420	265	215	215	265	
18			11,700	2,170	1,910	1,040	365	265	215	215	265	
19			10,600	2,170	1,820	1,040	365	265	215	215	265	
20			9,940	2,170	1,740	925	365	420	215	215	265	
21			9,320	2,170	1,740	925	315	475	215	215	265	
22			8,720	2,170	1,740	925	315	365	215	215	265	
23			8,530	2,170	1,660	925	315	265	215	215	265	
24			7,600	2,170	1,660	865	315	265	215	265	265	
25			7,240	2,170	1,590	865	315	265	215	265	265	
26			6,730	2,350	1,590	805	265	265	265	265	265	
27			6,240	2,540	1,520	805	265	265	265	265	265	175
28			5,760	2,640	1,520	805	265	265	265	265	265	
29			5,160	2,840	1,520	805	265	265	265	265	265	
30			4,870	3,060	1,440	805	265	215	265	265	265	
31			4,590		1,440		265	215		265		

[a] Daily discharge computed from a fairly well-defined rating curve. The estimates have been revised since they were published in "Report of Water Resources Investigation of Minnesota during 1909–10."

Monthly discharge of Minnesota River near Mankato, Minn., for 1903–1910.

[Drainage area, 14,600 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1903.						
May (20–31)	38,700	7,560	18,900	1.29	0.58	C.
June	27,200	2,440	6,980	.478	.53	B.
July	6,960	2,980	5,110	.350	.40	B.
August	5,460	2,490	3,430	.235	.27	B.
September	27,300	2,980	10,200	.699	.78	B.
October	20,500	3,770	9,430	.646	.74	B.
November	3,650	970	2,000	.137	.15	B.
December	1,340	1,160	1,210	.083	.10	C.
1904.						
January	1,160	560	687	.047	.05	C.
February			[a] 500	.034	.04	D.
April	7,740	2,540	5,130	.351	.39	B.
May	4,760	1,460	2,740	.188	.22	B.
June	3,040	1,420	2,120	.145	.16	B.
July	1,940	950	1,310	.090	.10	B.
August	1,102	540	751	.051	.06	B.
September	910	470	591	.040	.04	B.
October	1,050	470	701	.048	.06	B.
November	870	625	733	.050	.06	B.
December			[a] 460	.032	.04	C.

[a] Estimated

Monthly discharge of Minnesota River near Mankato, Minn., for 1903–1910—Continued.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1905.						
January	.....	.....	[a] 300	0.021	0.02	D.
February	.....	.....	[a] 400	.027	.03	D.
March	5,620	1,730	3,640	.249	.29	C.
April	3,520	1,180	2,330	.160	.18	B.
May	11,900	1,180	5,820	.399	.46	B.
June	4,900	2,160	3,220	.221	.25	B.
July	18,600	3,650	9,430	.646	.74	B.
August	3,460	1,380	2,160	.148	.17	B.
September	2,930	1,220	1,550	.106	.12	B.
October	1,420	1,060	1,270	.087	.10	B.
November	1,950	1,220	1,640	.112	.12	B.
December	.....	.....	[a] 1,250	.086	.10	C.
The year	.....	.....	2,750	.188	2.58	
1906.						
April	9,290	4,580	6,590	.451	.50	C.
May	7,600	3,550	4,560	.312	.36	C.
June	9,940	7,780	8,680	.595	.66	C.
July	7,600	2,820	5,020	.344	.40	B.
August	7,600	2,720	5,250	.360	.42	B.
September	7,030	4,220	5,680	.389	.43	B.
October	5,700	2,200	3,630	.249	.29	B.
November	5,840	3,490	4,780	.327	.36	B.
1907.						
March (21–31)	10,200	7,780	9,050	.620	.25	C.
April	13,600	4,470	8,360	.573	.64	C.
May	6,460	3,600	4,480	.307	.35	C.
June	22,100	4,860	14,400	.986	1.10	B.
July	14,600	5,000	8,140	.558	.64	B.
August	4,860	1,900	3,010	.206	.24	B.
September	4,600	1,540	2,630	.180	.20	B.
October	2,300	1,060	1,510	.103	.12	B.
November	1,900	1,060	1,380	.094	.10	B.
1908.						
March (16–31)	4,600	3,490	3,920	.268	.16	C.
April	5,840	3,380	3,910	.268	.30	C.
May	32,000	3,720	10,900	.747	.86	C.
June	43,800	12,000	23,400	1.60	1.78	C.
July	30,500	7,260	16,500	1.13	1.30	C.
August	7,090	1,810	3,350	.229	.26	C.
September	1,810	835	1,100	.075	.08	C.
October	1,300	835	975	.067	.08	C.
November	1,380	835	969	.066	.07	C.
1909.						
March (16–31)	31,400	7,240	15,700	1.08	.64	C.
April	29,900	7,420	16,000	1.10	1.23	C.
May	8,340	3,520	5,200	.356	.41	C.
June	13,300	6,080	8,250	.565	.63	C.
July	14,000	1,520	6,120	.419	.48	C.
August	2,950	925	1,510	.103	.12	C.
September	925	640	769	.053	.06	C.
October	695	475	613	.042	.05	C.
November	5,920	585	2,390	.164	.18	C.
1910.						
January	.....	.....	[a] 800	.055	.06	D.
February	.....	.....	[a] 575	.039	.04	C.
March	20,000	500	7,760	.532	.61	B.
April	3,780	2,170	2,650	.182	.20	B.
May	2,840	1,440	1,880	.129	.15	B.
June	1,440	805	1,040	.071	.08	B.
July	805	265	462	.032	.04	B.
August	475	165	246	.017	.02	B.
September	265	165	218	.015	.02	B.
Octboer	265	215	231	.016	.02	B.
November	315	265	285	.020	.02	B.
December	.....	.....	[a] 220	.015	.02	C.
The year	20,000	.....	1,370	.094	1.28	

[a] Estimated.

WHETSTONE RIVER NEAR BIG STONE, S. DAK.

Whetstone River enters Minnesota River a short distance below Big Stone Lake. Owing to the character of its drainage basin, which lies almost wholly in the northeastern part of South Dakota, it is a very flashy stream, having very little flow except in the spring and after heavy rain. It has no tributaries near its mouth. The drainage area of the Whetstone River is 441 square miles.

The gaging station, which is located at the State Line bridge, one-fourth of a mile southeast of Big Stone, S. Dak., was established September 18, 1909.

From December to March the relation between gage heights and discharge is affected by ice, and during that time observations are discontniued.

The station has not yet been completely rated, so no estimates of daily discharge are given.

From April 15, 1899, to May 14, 1904, records of flow were maintained by the United States Engineer Corps near the site of the present station. These records have been published in "Report of water resources investigations of Minnesota during 1909–10," by the State drainage commission, St. Paul, Minn.

Discharge measurements of Whetstone River at Big Stone, S. Dak., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 25	G. A. Gray	38	94.6	3.80	14.2
Aug. 16	C. J. Emerson	11	5.9	3.80	9.7
Sept. 18	G. A. Gray	13	5.0	.65	5.0
1910.					
Mar. 15	G. A. Gray	72	249	4.66	399
Apr. 15	do	32	40.5	1.40	65.6
29	Robert Follansbee	32	73.6	3.10	170

NOTE.—After Sept. 18, 1909, inclusive, the gage heights refer to a different gage and section.

Daily gage height, in feet, of Whetstone River at Big Stone, S. Dak., for 1910.

[F. W. Thorndike, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		1.85	2.7	1.0	0.6	0.5	0.6	0.7	0.7
2		1.75	2.55	1.0	.5	.5	.6	.7	.7
3		1.8	2.2	1.0	.5	.5	.6	.7	.7
4		1.8	2.05	.9	.5	.5	.6	.65	.8
5		1.7	2.0	.9	.6	.5	.6	.6	.8
6		1.6	1.9	.9	.6	.5	.6	.6	.8
7		1.6	1.9	.9	.6	.5	.6	.6	.8
8	[a]11.6	1.6	1.8	.9	.6	.5	.5	.55	.8
9		1.6	1.8	1.1	.6	.5	.5	.5	.85
10		1.55	1.8	1.2	.6	.5	.5	.5	.8
11		1.45	1.7	1.2	.6	.5	.5	.5	1.05
12		1.4	1.6	1.3	.6	.5	.5	.5	.85
13		1.35	1.6	1.3	.6	.6	.5	.5	.85
14		1.3	1.5	1.2	.6	.6	.5	.5	.85
15		1.35	1.4	1.1	.6	.6	.5	.5	.8

[a] High-water mark.

Daily gage height, in feet, of Whetstone River at Big Stone, S. Dak., for 1910—Contd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	3.75	1.55	1.4	1.0	0.6	0.7	0.5	0.5	1.00
17	3.45	1.55	1.4	.9	.6	.7	.5	.55	.85
18	3.2	1.4	1.4	.9	.5	.7	.5	.6	.8
19	3.05	1.45	1.4	.8	.5	.7	.5	.8	.95
20	3.0	1.55	1.3	.7	.5	.7	.5	.9	.8
21	2.9	2.5	1.3	.7	.5	.7	.5	.9	1.05
22	2.8	8.5	1.3	.6	.5	.7	.5	.9	.85
23	2.65	7.45	1.3	.6	.5	.7	.5	.8	.9
24	2.5	4.9	1.2	.5	.5	.7	.5	.8	.95
25	2.35	4.15	1.2	.5	.5	.6	.55	.8	.8
26	2.25	3.8	1.2	.75	.5	.6	.75	.8	.85
27	2.1	3.6	1.15	.9	.5	.6	.8	.8	.9
28	2.0	3.35	1.1	.75	.5	.6	.8	.7	.9
29	1.95	3.1	1.1	.7	.5	.6	.8	.7	.9
30	2.0	2.85	1.1	.65	.5	.6	.8	.7	.9
31	1.9	.....	1.0	.....	.5	.6	.....	.7	.....

NOTE.—Ice present from Jan. 1 to Mar. 7 and from Dec. 1 to 31.

LAC QUI PARLE RIVER AT LAC QUI PARLE, MINN.

Lac Qui Parle River rises in a small lake in the southeastern part of Deuel County, S. Dak., and flows northeastward into the Minnesota in sec. 24, T. 118 N., R. 42 W.

The gaging station, which is located at the highway bridge at the discontinued post office of Lac Qui Parle, in sec. 26, T. 118 N., R. 42 W., was established April 27, 1910, in connection with a general study of the run-off of the Minnesota basin.

The nearest tributary, Threemile Creek, enters the river a short distance below Lac Qui Parle. The drainage area above the station is 677 square miles and above the mouth 739 square miles.

There are no dams on the river which control the flow at the present time.

As the station has not been established sufficiently long to be rated no estimates of flow have been made and only the base data are given.

Records are discontinued from December to March, during which period the river is frozen over.

The gage is located at the bridge and measurements made at the same section.

Discharge measurements of Lac Qui Parle River at Lac Qui Parle, Minn., for 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 27	Robert Follansbee	46	181	3.53	278
July 8	.....do	40	74.7	1.13	17.6

Daily gage height, in feet, of Lac Qui Parle River at Lac Qui Parle, Minn., in 1910.

[Chas. A. Gould, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		2.82	1.45	1.38	0.70	0.70	0.85	0.90
2		2.72	1.42	1.28	.72	.70	.85	.88
3		2.62	1.38	1.23	.80	.70	.90	.90
4		2.52	1.38	1.18	.75	.70	.90	1.00
5		2.42	1.38	1.13	.80	.70	.85	1.00
6		2.35	1.40	1.63	.75	.70	.80	1.10
7		2.30	1.42	1.23	.70	.70	.82	1.00
8		2.28	1.42	1.18	.70	.70	.82	.95
9		2.22	1.52	1.13	.70	.70	.80	.90
10		2.18	1.72	1.13	.70	.68	.78	.80
11		2.12	2.02	1.08	.70	.68	.75	.92
12		2.08	2.72	1.18	.65	.65	.75	1.00
13		2.02	2.82	1.18	.72	.68	.75	.90
14		1.98	2.62	1.18	.70	.65	.75	.95
15		1.92	2.38	1.13	.80	.70	.75	.90
16		1.92	2.18	1.13	.85	.68	.75	.....
17		1.98	1.98	1.08	1.15	.68	.75	.....
18		1.98	1.78	1.06	1.05	.68	.75	.....
19		1.98	1.62	.98	.95	.68	.90	.....
20		2.08	1.52	.93	.90	.68	.82	.....
21		2.00	1.48	.88	.95	.68	.80	.....
22		1.95	1.38	.86	1.00	.70	.80	.....
23		1.92	1.32	.83	.90	.70	.85	.....
24		1.85	1.28	.80	.95	.70	.90	.....
25		1.78	1.22	.78	.90	.70	.90	.....
26		1.72	1.22	.76	.85	.80	.90	.....
27	3.52	1.68	1.22	.73	.80	.80	.90	.....
28	3.40	1.62	1.22	.78	.80	.82	.90	.....
29	3.22	1.58	1.32	.73	.75	.85	.90	.....
30	3.08	1.50	1.38	.73	.80	.90	.90	.....
31		1.48	.....	.73	.75	.....	.90	.....

NOTE.—Ice present from Nov. 16 to Dec. 31.

CHIPPEWA RIVER NEAR WATSON, MINN.

Chippewa River rises in T. 131 N., R. 38 W., in Ottertail County, flows southward through Lakes Moses, Aaron, Stowe, and Long, and enters Minnesota River at Montevideo.

The gaging station, which is located at the highway bridge about 2½ miles northeast of Watson, on line between secs. 10 and 15, T. 118 N., R. 41 W., was established July 6, 1909. The records of flow will be of value in devising means for flood prevention.

No important tributary enters between the station and the mouth of the river, about 10 miles distant. Dry Weather Creek enters the Chippewa about 2 miles above the station.

A water-power plant at Montevideo utilizes a head of 7 feet, but the backwater from the dam does not extend to the gaging station. The first dam above the station is at Hagan, but the effect of the control is unappreciable at Watson.

From December to March observations are suspended because of ice.

Since the installation of the gage its datum has remained unchanged.

During 1910 conditions were favorable for accurate results, and therefore the records may be considered reliable.

Discharge measurements of Chippewa River near Watson, Minn., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 13	G. A. Gray	116	381	[a] 8.22	474
23	C. J. Emerson	114	306	7.95	675
Apr. 14	G. A. Gray	88	154	6.18	253
July 8	Robert Follansbee	37	33.5	4.26	14.4

[a] Backwater from ice jam.

Daily gage height, in feet, of Chippewa River near Watson, Minn., for 1910

[Clifford Bonde, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	6.78	5.20	4.31	4.00	4.00	4.32	4.30
2	.....	6.56	5.12	4.28	4.05	4.00	4.28	4.40
3	.....	6.46	5.08	4.26	.....	4.02	4.32	4.35
4	.....	6.36	5.08	4.31	3.98	.....	4.28	4.35
5	.....	6.22	5.08	4.28	3.92	4.02	4.25	4.32
6	.....	6.10	5.10	4.51	3.92	4.00	4.20	4.35
7	.....	6.00	5.08	4.41	3.90	4.02	4.25	4.30
8	.....	5.98	5.02	4.28	3.90	3.98	4.20	4.32
9	.....	5.88	5.08	4.28	3.90	3.95	4.18	4.32
10	6.50	5.82	5.08	.....	3.98	3.95	4.18	4.28
11	6.51	5.75	5.08	.....	3.95	3.92	4.25	.....
12	6.42	5.65	5.08	4.42	3.92	3.98	4.22	.....
13	6.28	5.60	5.02	4.40	4.00	3.98	4.20	.....
14	6.19	5.58	4.90	4.35	3.95	3.95	4.15	.....
15	6.52	5.55	4.85	4.32	4.08	3.98	4.18	.....
16	6.82	5.52	4.78	4.30	4.10	3.98	4.15	.....
17	6.82	5.65	4.75	4.25	4.10	3.95	.....	.....
18	6.70	5.65	4.70	4.20	4.00	.....	4.10	.....
19	7.52	5.62	4.65	4.15	4.00	3.95	4.15	.....
20	7.92	6.00	4.60	4.10	4.30	3.92	4.30	.....
21	7.98	6.00	4.50	4.10	4.18	3.90	4.28	.....
22	8.00	5.98	4.45	4.08	4.10	3.90	4.30	.....
23	7.68	5.98	4.42	4.05	4.10	3.90	4.30	.....
24	7.78	5.90	4.40	4.08	4.10	3.90	4.30	.....
25	7.82	5.78	4.42	4.05	4.10	4.10	4.35	.....
26	7.85	5.70	4.40	4.10	4.10	4.20	4.35	.....
27	7.68	5.60	4.35	4.08	4.08	4.15	4.35	.....
28	7.45	5.48	4.35	4.05	4.08	4.12	4.30	.....
29	7.18	5.48	4.30	4.02	4.05	4.08	4.22	.....
30	6.95	5.38	4.28	4.00	4.10	4.00	4.25	.....
31	.....	5.25	.....	3.95	4.05	.....	4.20	.....

NOTE.—Ice present from Nov. 11 to Dec. 31.

Daily discharge, in second-feet, of Chippewa River near Watson, Minn., for 1910.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	384	92	15	12	12	15	15
2	.....	336	81	15	12	12	15	17
3	.....	315	75	15	12	12	15	16
4	.....	294	75	15	12	12	15	16
5	.....	266	75	15	11	12	14	15
6	.....	243	78	20	11	12	14	16
7	.....	224	75	17	11	12	14	15
8	.....	220	68	15	11	12	14	15
9	.....	202	75	15	11	12	14	15
10	323	192	75	16	12	12	14	15
11	325	180	75	17	12	11	14	.....
12	306	162	75	18	11	12	14	.....
13	278	154	68	17	12	12	14	.....
14	260	151	53	16	12	12	14	.....
15	327	146	48	15	13	12	14	.....

Daily discharge, in second-feet, of Chippewa River near Watson, Minn., for 1910—Contd.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	392	141	40	15	13	12	14	.....
17	392	162	37	14	13	12	13	.....
18	366	162	32	14	12	12	13	.....
19	555	157	28	14	12	12	14	.....
20	651	224	25	13	15	11	15	.....
21	665	224	20	13	14	11	15	.....
22	670	220	18	13	13	11	15	.....
23	593	220	18	12	13	11	15	.....
24	617	206	17	13	13	11	15	.....
25	627	185	18	12	13	13	16	.....
26	634	171	17	13	13	14	16	.....
27	593	154	16	13	13	14	16	.....
28	538	135	16	12	13	13	15	.....
29	474	135	15	12	12	13	14	.....
30	422	119	15	12	13	12	14	.....
31	.....	100	.....	12	12	.....	14	.....

NOTE.—Daily discharges computed from a well-defined rating curve.

Monthly discharge of Chippewa River near Watson, Minn., for 1910.

[Drainage area, 1,940 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
April (10–30)	670	260	477	0.246	0.19	B.
May	384	100	199	.103	.12	A.
June	92	15	47.3	.024	.03	A.
July	20	12	14.5	.0075	.009	A.
August	15	11	12.3	.0063	.007	A.
September	14	11	12.0	.0062	.007	B.
October	16	13	14.5	.0075	.009	B.
November (1–10)	17	15	15.5	.0079	.003	B.

REDWOOD RIVER NEAR REDWOOD FALLS, MINN.

Redwood River rises in T. 108 N., R. 44 W., in Pipestone County and flows northeastward into Minnesota River in T. 113 N., R. 35 W. Its chief tributary is Threemile Creek. Before emptying into the Minnesota, Redwood River falls 80 feet or more at Redwood Falls. This fall has been utilized in lighting that city.

The gaging station, which is located about 3 miles above Redwood Falls at the first highway bridge, was established July 2, 1909, as part of the general plan for investigating the water resources of the Minnesota.

During all stages except low, discharge measurements are made from the bridge; low-water measurements are made by wading at different sections.

The nearest dam, that at Redwood Falls, creates a pond that extends upstream for a considerable distance, but rapids just below the gaging station prevent backwater effects at the gage.

Observations are discontinued from December to March because of ice.

The gage datum has remained unchanged since the gage was established.

Conditions at this station are favorable for excellent results and the records should therefore be reliable.

Discharge measurements of Redwood River near Redwood Falls, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 2	Robert Follansbee	88	370	4.20	781
22	G. A. Gray	77	256	2.85	222
Aug. 13[a]	C. J. Emerson	34	57.6	2.18	50.0
1910.					
Mar. 21	C. J. Emerson	80	248	2.86	220
July 6[a]	Robert Follansbee	24	19.1	2.03	21.0
Aug. 19	.....do	.....	.....	1.71	[b] 4.0

[a] Wading section. [b] Estimated.

Daily gage height, in feet, of Redwood River near Redwood Falls, Minn., for 1910.

[Wallace Stewart, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.42	2.22	1.90	1.92	1.70	1.75	1.90	1.95
2	.....	2.40	2.20	1.90	1.88	1.70	1.72	1.92	1.98
3	.....	2.40	2.18	1.90	1.88	1.70	1.72	1.98	1.95
4	.....	2.40	2.10	1.90	1.85	1.70	1.70	2.00	1.92
5	.....	2.40	2.10	1.90	1.85	1.70	1.70	2.00	1.90
6	.....	2.40	2.08	1.90	1.82	1.70	1.70	2.00	1.90
7	.....	2.38	2.02	1.90	1.80	1.70	1.70	2.00	1.90
8	.....	2.38	2.08	1.92	1.80	1.70	1.68	1.98	1.92
9	.....	2.35	2.05	2.00	1.85	1.70	1.68	1.95	1.92
10	.....	2.30	2.05	2.08	1.80	1.70	1.68	1.90	1.90
11	.....	2.30	2.05	2.18	1.80	1.70	1.70	1.92	1.90
12	.....	2.28	2.02	2.25	1.85	.....	1.70	1.92	1.92
13	.....	2.30	2.05	2.30	1.85	.....	1.70	1.90	.....
14	.....	2.28	2.00	2.25	1.85	.....	1.68	1.90	.....
15	.....	.....	2.00	2.20	1.82	.....	1.68	1.90	.....
16	.....	.....	2.00	2.15	1.80	.....	1.70	1.88	.....
17	.....	2.30	2.05	2.10	1.80	.....	1.75	1.90	.....
18	.....	2.35	2.00	2.00	1.80	.....	1.75	1.90	.....
19	.....	2.45	2.00	1.98	1.80	1.72	1.78	1.90	.....
20	.....	2.40	2.10	1.98	1.80	1.75	1.80	1.98	.....
21	.....	2.40	2.05	1.98	1.75	1.75	1.80	2.02	.....
22	.....	2.45	2.00	1.90	1.75	1.75	1.82	2.10	.....
23	.....	2.45	2.30	1.85	1.75	1.72	1.82	2.08	.....
24	.....	2.45	2.28	1.85	1.75	1.72	1.82	2.05	.....
25	2.65	2.45	2.18	2.25	1.70	1.72	1.82	2.02	.....
26	2.52	2.40	2.10	2.05	1.70	1.72	1.85	2.00	.....
27	2.52	2.35	2.05	1.90	1.70	1.70	1.82	1.95	.....
28	2.58	2.32	2.00	1.95	1.70	1.70	1.80	1.92	.....
29	2.42	2.30	2.00	2.08	1.70	1.70	1.80	1.90	.....
30	2.42	2.25	1.98	2.08	1.70	1.78	1.85	1.92	.....
31	2.42	.....	1.92	.....	1.70	1.75	.....	1.92	.....

NOTE.—Ice present from Nov. 13 to Dec. 31.

Daily discharge, in second-feet, of Redwood River near Redwood Falls, Minn., for 1909–10.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1909.									
1						58	33	14	21
2					772	52	33	12	18
3					720	54	35	12	16
4					641	50	32	12	16
5					596	50	26	12	16
6					538	42	26	12	18
7					504	42	26	12	18
8					500	40	25	12	18
9					454	40	25	15	18
10					430	40	23	14	18
11					330	40	21	14	18
12					338	48	25	14	18
13					402	47	23	14	20
14					375	65	20	14	20
15					308	130	19	14	20
16					272	158	16	14	20
17					258	176	16	16	20
18					279	185	16	14	20
19					268	201	17	14	20
20					240	207	16	14	42
21					224	201	16	14	50
22					188	185	17	14	50
23					156	161	16	16	50
24					133	130	16	16	33
25					120	107	16	14	42
26					107	92	16	14	50
27					92	78	16	14	50
28					80	65	16	12	50
29					65	54	14	12	50
30					65	48	14	13	50
31					67	40	.....	14	.....
1910.									
1	.....	97	54	12	14	4	5.5	12	16
2	.....	92	50	12	11	4	4.6	14	18
3	.....	92	47	12	11	4	4.6	18	16
4	.....	92	33	12	9.5	4	4	20	14
5	.....	92	33	12	9.5	4	4	20	12
6	.....	92	30	12	8	4	4	20	12
7	.....	88	23	12	7	4	4	20	12
8	.....	88	30	14	7	4	3.5	18	14
9	.....	80	26	20	9.5	4	3.5	16	14
10	.....	69	26	30	7	4	3.5	12	12
11	.....	69	26	47	7	4	4	14	12
12	.....	65	23	60	9.5	4	4	14	14
13	.....	69	26	69	9.5	4	4	12	.....
14	.....	65	20	60	9.5	4	3.5	12	.....
15	.....	66	20	50	8	4	3.5	12	.....
16	.....	68	20	42	7	4	4	11	.....
17	.....	69	26	33	7	4	5.5	12	.....
18	.....	80	20	20	7	4	5.5	12	.....
19	.....	104	20	18	7	4.6	6.4	12	.....
20	.....	92	33	18	7	5.5	7	18	.....
21	.....	92	26	18	5.5	5.5	7	23	.....
22	.....	104	20	12	5.5	5.5	8	33	.....
23	.....	104	69	9.5	5.5	4.6	8	30	.....
24	.....	104	65	9.5	5.5	4.6	8	26	.....
25	158	104	47	60	4	4.6	8	23	.....
26	122	92	33	26	4	4.6	9.5	20	.....
27	122	80	26	12	4	4	8	16	.....
28	139	73	20	16	4	4	7	14	.....
29	97	69	20	30	4	4	7	12	.....
30	97	60	18	30	4	6.4	9.5	14	.....
31	97	.....	14	.....	4	5.5	.....	14	.....

NOTE.—Daily discharge computed from a fairly well-defined rating curve.

Monthly discharge of Redwood River near Redwood Falls, Minn., for 1909–10.

[Drainage area, 703 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
July (2-31)	772	65	317	0.451	0.50	A.
August	207	40	93.1	.132	.15	A.
September	35	14	21.0	.030	.03	A.
October	16	12	13.6	.019	.02	B.
November	50	16	29.0	.041	.05	B.
1910.						
March (25-31)	158	97	119	.169	.04	B.
April	104	60	83.7	.119	.13	A
May	69	14	30.5	.043	.05	A.
June	69	9.5	26.3	.037	.04	A.
July	14	4.0	7.16	.010	.01	A.
August	6.4	4.0	4.37	.0062	.007	B.
September	9.5	3.5	5.62	.0080	.009	B.
October	33	12	16.9	.024	.03	B.
November (1-12)	18	12	13.8	.020	.009	B.

COTTONWOOD RIVER NEAR NEW ULM, MINN.

Cottonwood River rises in Black Rush Lake, in T. 110 N., R. 42 W., Lyon County, and flows eastward into the Minnesota near New Ulm.

The gaging station, which is located at the Alwin highway bridge, about 2 miles southwest of New Ulm, in sec. 31, T. 110 N., R. 30 W., and about 3½ miles above the mouth of the river, was established July 2, 1909, in accordance with the general plan of studying the water resources of the Minnesota River basin.

The nearest important tributary, Sleepy Eye Creek, enters the river 15 miles above the station.

The dam of the Cottonwood Roller Mill, 2 miles below the station, prevents any possible effect of backwater from the Minnesota reaching the gage. Though the dam itself may be the control for the station, the low-water records show no systematic variation which would indicate such control.

Observations of flow are suspended from December to March because of ice.

Discharge measurements are made from the bridge to which the chain gage is attached.

On August 12, 1909, the datum of the gage was lowered 2.28 feet. All readings prior to that date have been corrected and all gage heights apply to the new datum.

Although the channel changed somewhat during 1910, this change was slight until the latter part of the year, and as the rating table was applied indirectly during that period it is believed the estimates are good.

Discharge measurements of Cottonwood River near New Ulm, Minn., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 20	C. J. Emerson	123	238	3.82	610
July 5	Robert Follansbee	48	38.6	1.56	39.0
5	do	48	38.6	1.56	40.9
Oct. 28	C. J. Emerson	48	29.1	1.42	19.4

Daily gage height, in feet, of Cottonwood River near New Ulm, Minn., for 1910.

[Miss Ester Alwin, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.69	2.12	1.74	1.79	1.36	1.28	1.28	1.42
2	.....	2.62	2.01	1.72	1.74	1.38	1.25	1.28	1.42
3	.....	2.59	1.99	1.72	1.65	1.40	1.21	1.30	1.42
4	.....	2.53	1.96	1.70	1.61	1.36	1.20	1.33	1.36
5	.....	2.47	1.94	1.70	1.69	1.28	1.22	1.30	1.26
6	.....	2.42	1.90	1.74	1.68	1.25	1.25	1.30	1.29
7	.....	2.37	1.90	1.73	1.56	1.36	1.25	1.30	1.36
8	.....	2.34	1.87	1.74	1.52	1.38	1.24	1.30	1.41
9	.....	2.29	1.87	1.84	1.59	1.35	1.21	1.30	1.42
10	.....	2.28	1.85	2.04	1.59	1.35	1.18	1.30	1.34
11	8.68	2.20	1.85	2.20	1.56	1.32	1.18	1.32	1.49
12	5.44	2.19	1.83	2.60	1.55	1.30	1.25	1.33	1.49
13	5.21	2.17	1.83	2.88	1.52	1.34	1.22	1.33	1.46
14	4.81	2.10	1.84	2.56	1.55	1.34	1.22	1.33	1.48
15	4.60	2.12	1.85	2.44	1.52	1.36	1.25	1.33	1.48
16	4.44	2.10	1.90	2.31	1.51	1.38	1.25	1.33	1.49
17	4.24	2.14	1.99	2.20	1.49	1.35	1.22	1.33	1.52
18	4.08	2.30	2.03	2.10	1.46	1.34	1.20	1.33	1.62
19	3.98	2.44	2.01	1.94	1.45	1.35	1.20	1.33	1.66
20	3.78	2.40	2.01	1.88	1.42	1.40	1.20	1.36	1.58
21	3.72	2.43	2.04	1.86	1.42	1.38	1.24	1.40	1.58
22	3.58	2.53	2.07	1.82	1.40	1.38	1.22	1.39	1.62
23	3.46	2.56	2.04	1.80	1.39	1.38	1.22	1.38	1.49
24	3.38	2.50	2.00	1.77	1.38	1.35	1.25	1.39	1.42
25	3.29	2.47	1.99	1.74	1.38	1.35	1.26	1.40	1.45
26	3.08	2.40	1.93	1.69	1.35	1.32	1.30	1.42	1.44
27	3.02	2.29	1.91	1.66	1.36	1.31	1.35	1.43	1.41
28	2.92	2.24	1.83	1.65	1.38	1.30	1.32	1.43	1.42
29	2.86	2.18	1.82	1.78	1.36	1.29	1.32	1.42	1.46
30	2.80	2.13	1.80	1.82	1.35	1.29	1.30	1.40	1.51
31	2.74	.....	1.77	.....	1.32	1.30	.....	1.40	.....

NOTE.—Ice present from Jan. 1 to Mar. 10 and from Dec. 1 to 31.

Daily discharge, in second-feet, of Cottonwood River near New Ulm, Minn., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	224	112	61	67	20	11	9	19
2	.....	207	96	58	61	21	10	9	19
3	.....	200	93	58	51	22	8	10	19
4	.....	187	88	56	47	20	7	11	15
5	.....	174	86	56	55	15	8	10	8
6	.....	164	80	61	54	14	10	10	10
7	.....	155	80	60	42	20	10	10	15
8	.....	149	76	61	38	21	10	10	18
9	.....	140	76	73	45	19	8	10	19
10	.....	139	74	100	45	19	6	10	14
11	3,250	125	74	125	37	17	6	11	27
12	1,380	123	72	202	36	16	10	11	27
13	1,260	120	72	275	34	18	8	11	23
14	1,060	109	73	193	36	18	8	11	26
15	965	112	74	168	34	20	10	11	26

Daily discharge, in second-feet, of Cottonwood River near New Ulm, Minn., for 1910— Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	893	109	80	144	33	21	10	11	27
17	803	115	93	125	31	19	8	11	28
18	731	142	98	109	29	18	7	11	37
19	686	168	96	86	28	19	7	11	42
20	597	160	96	78	26	22	7	12	35
21	573	166	100	75	26	21	9	14	35
22	517	187	104	70	24	21	8	14	37
23	469	193	100	68	23	21	8	13	27
24	438	180	94	64	23	19	10	14	19
25	406	174	93	61	23	19	10	14	24
26	334	160	84	55	20	17	12	15	23
27	316	140	81	52	21	17	15	15	18
28	286	132	72	51	23	16	13	15	19
29	269	122	70	66	21	16	13	15	23
30	252	114	68	70	20	15	12	14	28
31	236	.....	64	.....	18	14	.....	14	.....

NOTE.—Daily discharge computed from a fairly well-defined rating curve. After July 10 the rating curve was applied indirectly.

Monthly discharge of Cottonwood River near New Ulm, Minn., for 1910.

[Drainage area, 1,190 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
March (11-31)	3,250	236	511	0.429	0.34	B.
April	224	109	297	.250	.28	B.
May	112	64	84.5	.071	.08	B.
June	275	51	92.7	.078	.09	B.
July	67	18	34.5	.029	.03	A.
August	22	14	18.5	.016	.02	B.
September	15	6	9.30	.008	.01	C.
October	15	9	11.8	.01	.01	B.
November	42	8	23.6	.02	.02	B.

BLUE EARTH RIVER AT RAPIDAN MILLS, MINN.

Blue Earth River rises in Kossuth County, Iowa, and flows northward into the Minnesota near Mankato.

The gaging station, which is located at Rapidan Mills, 2 miles west of Rapidan, in sec. 8, T. 107 N., R. 27 W., and 9 miles above the mouth of the river, was originally established, July 20, 1909, at the highway bridge at Rapidan Mills. On April 29, 1910, the bridge station was discontinued, owing to the erection of a dam just below the section which would completely submerge the bridge. At this time a new gage was installed a few hundred yards downstream and below the dam. A cable was erected from which measurements are made. This new station was installed in cooperation with the Consumers' Power Co., which has furnished the gage readings since September, 1910.

The records at this station not only furnish data in regard to the power available on Blue Earth River, but when used in connection with the records of the Minnesota near Mankato will indicate the discharge of Minnesota River above the Blue Earth, information essential in connection with flood-prevention work.

The nearest tributary of appreciable size is Watonwan River, which enters Blue Earth about 3 miles above the gaging station. Between the station and the mouth, Blue Earth River receives Le Sueur River, which drains an area comprising 1,160 square miles, but which at ordinary stages carries a very small run-off.

The river at the gaging station has a heavy fall, which is being utilized by the power plant, and although the dam is 56 feet high, it is stated that the backwater will not extend upstream more than 2 or 3 miles.

It was intended to maintain this station during the winter season of 1909–10, but ice gorging below the gage caused so much backwater and such unstable conditions that the records were discontinued.

On November 14, 1910, the gates in the new dam were closed to fill the reservoir, allowing only a small quantity of water to pass the gage. As this amount does not represent the true flow, observations were temporarily discontinued until the reservoir back of the dam is filled.

The rating table used prior to April 29, 1910, was fairly well defined and was applied directly, except during April, when shifting conditions made it necessary to be applied indirectly. The rating table for the present section is based on numerous weir measurements made during the lowest stages in addition to meter measurements at the higher stages, and therefore the records based on it should be excellent.

Discharge measurements of Blue Earth River near Rapidan Mills, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 20	G. A. Gray	128	450	4.28	1,590
Aug. 11	C. J. Emerson	106	234	2.60	243
Sept. 12	G. A. Gray	95	193	2.05	143
1910.					
Mar. 19	C. J. Emerson	150	715	6.14	4,010
26	do	134	520	4.80	1,840
Apr. 4	Robert Follansbee	121	370	3.65	869
May 25[a]	G. A. Gray	174	374	1.65	209
June 16[a]	A. M. Rosenblatt	170	378	1.60	212
22[a]	do	170	298	1.24	113

[a] New station.

Daily gage height, in feet, of Blue Earth River at Rapidan Mills, Minn., for 1910.

[A. M. Rosenblatt, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	3.93	1.64	1.32	1.20	0.90	0.90	1.15	1.12
2	.....	3.81	1.60	1.35	1.18	.95	.94	1.12	1.05
3	.....	3.71	1.57	1.27	1.16	.98	.92	1.18	1.18
4	.....	3.58	1.52	1.32	1.13	.86	.91	1.11	1.20
5	.....	3.50	1.50	1.30	1.11	.92	.98	1.05	1.18
6	.....	3.45	1.49	1.27	1.12	.82	1.00	.97	1.15
7	.....	3.30	1.47	1.30	1.13	.87	.98	1.05	1.23
8	.....	3.30	1.45	1.29	1.24	.84	1.00	.95	1.29
9	.....	3.10	1.45	1.34	1.22	.82	.91	.....	1.38
10	.....	.....	1.44	1.39	1.20	.83	.92	1.10	1.18
11	.....	.....	1.41	1.44	1.09	.90	.93	1.10	1.07
12	11.50	.....	1.40	1.56	1.07	.90	1.00	1.10	1.05
13	.....	.....	1.40	1.66	1.02	.92	.90	1.10	.....
14	.....	.....	1.41	1.76	1.03	.94	.85	1.10	.....
15	8.60	2.95	1.40	1.71	1.04	1.02	1.04	1.10	.....
16	7.90	2.90	1.42	1.60	1.10	1.04	.90	1.10	.....
17	7.40	3.00	1.48	1.53	1.10	1.04	.87	1.20	.....
18	7.20	2.95	1.47	1.46	1.02	.97	.88	1.15	.....
19	6.80	2.97	1.52	1.40	1.01	1.00	1.12	1.15	.....
20	5.90	3.00	1.52	1.36	.98	1.28	1.11	1.10	.....
21	5.65	3.00	1.53	1.35	.95	1.15	1.12	1.12	.....
22	5.45	3.05	1.57	1.24	1.05	1.04	.96	1.12	.....
23	5.32	3.05	1.62	1.28	.94	1.00	1.09	1.10	.....
24	5.15	3.15	1.63	1.20	1.02	.94	1.08	1.12	.....
25	4.98	3.12	1.62	1.24	.98	.92	1.00	1.17	.....
26	4.80	3.05	1.62	1.22	.98	.95	1.02	1.17	.....
27	4.63	3.07	1.58	1.22	.98	.90	1.04	1.20	.....
28	4.46	3.15	1.53	1.22	.90	.90	1.04	1.17	.....
29	4.38	[a] 1.67	1.49	1.20	.93	.90	1.15	1.17	.....
30	4.15	1.65	1.45	1.20	.88	.96	1.05	1.20	.....
31	4.03	.....	1.36	.....	.93	.95	.....	1.05	.....

[a] New gage installed below dam.

NOTE.—Mar. 12-19 gage heights estimated from temporary gage and may be somewhat in error. From Nov. 13 to Dec. 31 flow controlled by dam above station.

Daily discharge, in second-feet, of Blue Earth River at Rapidan Mills, Minn., for 1909–10

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1909.[a]									
1	.....	.....	.....	.....	.....	310	150	150	148
2	.....	.....	.....	.....	.....	290	152	141	166
3	.....	.....	.....	.....	.....	275	152	138	531
4	.....	.....	.....	.....	.....	257	128	136	1,180
5	.....	.....	.....	.....	.....	229	136	134	1,240
6	.....	.....	.....	.....	.....	209	138	132	1,130
7	.....	.....	.....	.....	.....	200	134	130	957
8	.....	.....	.....	.....	.....	186	131	127	788
9	.....	.....	.....	.....	.....	178	127	125	677
10	.....	.....	.....	.....	.....	206	126	123	689
11	.....	.....	.....	.....	.....	166	120	120	525
12	.....	.....	.....	.....	.....	150	133	118	503
13	.....	.....	.....	.....	.....	154	131	138	565
14	.....	.....	.....	.....	.....	170	134	170	788
15	.....	.....	.....	.....	.....	189	141	178	1,390
16	.....	.....	.....	.....	.....	565	141	164	.....
17	.....	.....	.....	.....	.....	601	145	175	.....
18	.....	.....	.....	.....	.....	609	145	175	.....
19	.....	.....	.....	.....	.....	542	150	152	.....
20	.....	.....	.....	.....	1,420	481	141	152	.....
21	.....	.....	.....	.....	990	435	143	145	.....
22	.....	.....	.....	.....	803	388	164	131	.....
23	.....	.....	.....	.....	677	352	170	127	.....
24	.....	.....	.....	.....	601	310	264	127	.....
25	.....	.....	.....	.....	508	283	310	128	.....

[a] Daily discharge computed from a well-defined rating curve.

Daily discharge, in second-feet, of Blue Earth River at Rapidan Mills, Minn., for 1909–10— Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1909.									
26					455	249	271	120	
27					388	232	235	123	
28					348	213	209	123	
29					352	195	189	126	
30					352	181	173	123	
31					335	166		143	
1910.[a]									
1		1080	213	115	86	30	36	75	68
2		981	199	123	82	38	36	68	54
3		901	189	103	77	42	33	82	82
4		803	173	115	71	26	32	66	86
5		745	166	110	66	33	42	54	82
6		711	163	103	68	21	45	40	75
7		613	157	110	71	27	42	54	93
8		613	151	108	96	23	45	38	108
9		497	151	120	91	21	32	51	131
10		478	148	133	86	22	33	64	82
11		459	139	148	62	30	34	64	77
12	13100	440	136	186	58	30	45	64	54
13	10000	420	136	221	49	33	30	64	
14	9000	450	139	258	51	36	24	64	
15	8200	380	136	239	53	49	53	64	
16	7010	340	142	199	64	53	30	64	
17	6160	385	160	176	64	53	27	86	
18	5820	335	157	154	49	40	28	75	
19	5140	340	173	136	47	45	68	75	
20	3650	320	173	126	42	105	66	64	
21	3260	320	176	123	38	75	68	68	
22	2960	300	189	96	54	53	39	68	
23	2760	280	206	105	36	45	62	64	
24	2520	300	210	86	49	36	60	68	
25	2280	290	206	96	42	33	45	79	
26	2040	230	206	91	42	38	49	79	
27	1830	235	192	91	42	30	53	86	
28	1620	225	176	91	30	30	53	79	
29	1530	224	163	86	34	30	75	79	
30	1290	217	151	86	28	39	54	86	
31	1170		126		34	38		54	

[a] Daily discharges for 1910 are computed from two rating curves that were well defined at the lower stages, but not so well at the higher stages.

Monthly discharge of Blue Earth River at Rapidan Mills, Minn., for 1909–10.

[Drainage area, 2,260 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
July (20–31)	1420	335	602	0.266	0.12	A.
August	689	150	292	.129	.15	A.
September	310	120	163	.072	.08	A.
October	178	118	139	.062	.07	A.
November			[a]700	.310	.35	C.
1910.						
March (12–31)	13100	1170	4570	2.02	1.50	C.
April	1080	217	462	.204	.23	B.
May	213	126	168	.074	.09	A.
June	258	86	131	.058	.06	A.
July	96	28	56.8	.025	.03	A.
August	105	21	38.8	.017	.02	A.
September	75	24	44.4	.020	.02	B.
October	86	38	67.3	.030	.03	B.
November (1–12)	131	54	82.6	.037	.02	B.

[a] Estimated.

ST. CROIX RIVER.

GENERAL FEATURES OF AREA DRAINED.

St. Croix River, which forms throughout the greater part of its length the boundary between Minnesota and Wisconsin, drains an area 7,580 square miles in extent lying in eastern Minnesota and northwestern Wisconsin. The river rises at an elevation of 1,010 feet above sea level, in Lake St. Croix, on the Lake Superior divide, only 20 miles from Lake Superior, and flows southwest and then south till it joins the Mississippi opposite Hastings, Minn. In its total length of 160 miles it descends 338 feet, all but 20 feet in the upper 116 miles.

Its principal tributaries are Manakagon, Yellow, Apple, and Willow rivers from the Wisconsin side, and Tamarack, Kettle, Snake, and Sunrise rivers from the Minnesota side.

Almost the entire basin is so thickly covered with glacial drift that rock outcrops, except near the rivers, are very rare. Probably throughout the greater part of the area the drift is underlain by the pre-Cambrian crystalline rocks, whose intersection with the St. Croix near Taylors Falls, Minn., causes the fall and rapids that extended previously for 6 or 7 miles above that point.

The country for the most part is gently undulating and is deeply trenched by the larger rivers which have cut through the drift and into the underlying rock.

The upper section of the drainage basin is timbered, but much of the growth is merely brush, as logging was carried on extensively in the basin for many years. The lower part of the basin is largely under cultivation.

The annual rainfall is about 30 inches, of which 3½ inches are precipitated as snow, which remains during the winter months. The rivers are frozen over except at rapids from December to March, and the flow is very uniform, decreasing gradually up to midwinter, when it is a minimum. As there are no winter thaws the flow is derived from the lakes and from underground water, and these do not cause winter freshets.

In the Wisconsin portion of the basin lakes are much more numerous than elsewhere. Many of the lakes are without surface outlet, and many others have been dammed to control the outflowing stream for logging.

In the Minnesota portions the lakes comprise less than 1 per cent of the area, and, as logging is no longer carried on, few of these lakes are controlled.

The lakes afford excellent reservoir sites, which could be utilized at a comparatively low cost.

The following table[1] shows the elevation at different points of the St. Croix River, and thus indicates the possibility of power development.

Elevations and distances along St. Croix River.

Place.	Distance above mouth.	Elevation above sea level.
	Miles.	*Feet.*
Prescott	0	667
Kinnickinnic River	5	668
Apple River	28	672
Osceola	42	683
St. Croix Falls (head of navigation)	48	687
St. Croix Falls (crest of dam)	.....	750
Trade River	60	753
Sunrise River	65	758
Rush City	75	773
Sec. 35, T. 38 N., R. 20 W	79	782
Snake River	86	790
Kettle River Rapids, foot	89	801
Kettle River	90	816
Kettle River Rapids, head	93	850
Clam River	101	868
Sec. 1, T. 40 N., R. 18 W	104	874
Yellow River	115	888
Namekagon River	127	908
Moose River	139	1,001
Sec. 35, T. 44 N., R. 13 W., below dam	144	1,001
Sec. 35, T. 44 N., R. 13 W., above dam	144	1,005
St. Croix Lake	160	1,010

Water power is developed at one point on the St. Croix River—at Taylors Falls—a head of 56 feet being utilized at a power plant having an installation of 26,000 horsepower.

St. Croix River is navigable from its mouth nearly to Taylors Falls, though little traffic is carried at present.

The United States Geological Survey has investigated the quality of the St. Croix water and published the results in Water-Supply Paper 193, entitled "The quality of surface waters in Minnesota." The only topographic sheet issued by the Survey for this basin is the St. Croix Dalles sheet, which covers the area in the vicinity of Taylors Falls.

The United States Engineer Corps made an examination of the St. Croix and its tributaries, and the results were published in House Document 39, Forty-sixth Congress, second session. The results of a second examination of the St. Croix, made in connection with the proposed Lake Superior and Mississippi canal, were published in House Document 330, Fifty-fourth Congress, first session.

KETTLE RIVER.

GENERAL FEATURES OF AREA DRAINED.

Kettle River, an important tributary of the St. Croix, drains an area in the eastern part of Minnesota, chiefly in Pine and Carlton counties. It rises in T. 49 N., R. 19 W., in Carlton County and flows

[1] From Water-Supply Paper U. S. Geol. Survey No. 156, p. 119.

southward into St. Croix River in T. 39 N., R. 19 W. Its chief tributaries are Moose, Willow, Moose Horn, Dead Moose, Split Rock, Pine, and Grindstone rivers. The following drainage areas have been measured in the basin:

Drainage areas in Kettle River basin.

Kettle River:	Square miles
Above Banning	825
Above mouth	1,030

The region is covered with red till—a mixture of sand and gravel and clay deposited by a glacier. In the northern part of the basin the drift is underlain by Archean greenstones and gneisses; in the southern part it rests on Cambrian sandstones, shales, and limestones.

Throughout the lower portion of its course Kettle River has cut through the drift into the sandstones, which yield water to the many springs found along the river.

The general surface of the basin is gently undulating, and the elevations range from 850 to 1,300 feet above sea level. The basin contains about 35 lakes, chiefly in its central part. The combined area of the lakes comprises less than 1 per cent of the drainage area.

The entire basin was originally densely forested, although it is now for the most part covered with brush. Much of the present growth consists of poplar and jack pine. Conditions are favorable for reproduction of the forest, as the forest fires which have occurred at various times have not seriously injured the soil. There is very little cleared land.

The mean annual precipitation in the basin ranges from 27 inches in the northern part to 29 inches in the southern. Of this amount $3\frac{1}{2}$ inches falls as snow which remains on the ground during the winter months. Owing to its heavy fall, Kettle River does not freeze entirely over, but as there are no winter thaws the only source of supply is the ground water and the lakes, and the flow is therefore very uniform, decreasing slowly until midwinter, when it is at a minimum.

Most of the lakes in the Kettle River basin lie so far up on the headwaters that they receive insufficient run-off to make them valuable as storage reservoirs. On Pine Lake is a dam which forms a reservoir for the use of the power plant at Sandstone. Logging is no longer carried on in this basin. Owing to its undulating character, the basin contains little swamp land.

The fall of Kettle River is heavy throughout its course and affords opportunity for water-power development.

The following table, compiled largely from a survey made by the Kettle River Power Co., shows the elevation of the water surface at different points:

Elevations and distances along Kettle River.

Place.	Distance above mouth.	Elevation above sea level.
	Miles.	*Feet.*
St. Croix River	0	816
	1	821
Township line 39–40	3	846
	4	861
	5	871
	6	889
Range line 19–20	9	894
Foot of rapids	18	899
Township line 41–42	19	910
Kettle River Power Co., new dam tail-water	22	913
Kettle River Power Co., new dam headwater	22	938
Kettle River Power Co., old dam, Sandstone, tail-water	24	938
Banning wagon bridge	26	983
Sec. 11, T. 43 N., R. 22 W	29	1,000
Kettle River	34	1,016
Township line T. 45–46	46	1,050
Sec. 8, T. 46 N., R. 20 W	53	1,100
Sec. 9, T. 47 N., R. 20 W	62	1,200
Sec. 35, T. 48 N., R. 20 W	67	1,250
Source	79	1,300

At the present time power is developed at two points near Sandstone, where a 34-foot fall is utilized in obtaining an average of 630 horsepower. At Sandstone are the celebrated Kettle River quarries, from which large quantities of building and paving material are taken elsewhere.

KETTLE RIVER NEAR SANDSTONE, MINN.

This station, which is located at the quarries of the Barber Asphalt Co., at Banning, 3 miles above Sandstone, was established October 18, 1908, by the Kettle River Quarries Co. to obtain data concerning the power available on the river. The gage heights prior to October 1, 1909, have been furnished through the courtesy of the quarries company; but since that date the station has been maintained in cooperation with the United States Geological Survey. The company has also furnished a rating for the section made by current meter, and as the stream flows at the gaging section through solid rock this rating should hold permanently. It has been checked by the Geological Survey.

No important tributaries enter within several miles of the station. The nearest dam is at Sandstone; but as there is a heavy fall in the 3 miles between the two points the station is above its influence.

The gage is 50 feet above decided rapids which remain open except for very short periods of extremely cold weather, when they may freeze and thus cause backwater. As the channel seldom freezes entirely over at the gage, it is probable that the open-channel rating

curve is applicable, except for the few days when the rapids freeze, and it has been used in computing the winter flow.

Since the installation of the gage, its datum has remained unchanged. Conditions are exceptionally favorable for excellent results at this station, and the records should therefore be reliable.

Daily gage height, in feet, of Kettle River near Sandstone, Minn., for 1910.

[Fred Elstad, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.0	1.45	1.6	3.3	2.1	1.8	1.25	1.0	1.2	1.5	1.3	1.1
2	2.9	1.45	1.65	3.15	2.1	1.75	1.25	1.0	1.2	1.6	1.25	1.1
3	2.75	1.5	1.7	3.0	2.05	1.7	1.2	1.05	1.2	1.6	1.3	1.1
4	2.7	1.5	1.85	2.95	2.0	1.65	1.2	1.1	1.2	1.5	1.3	1.1
5	2.7	1.45	2.05	3.0	2.0	1.7	1.15	1.1	1.2	1.45	1.3	1.2
6	2.5	1.45	2.1	2.95	1.95	1.75	1.1	1.1	1.25	1.45	1.05	1.2
7	2.3	1.45	2.1	2.9	1.9	1.7	1.1	1.05	1.25	1.4	1.3	1.3
8	2.2	1.45	2.15	2.8	1.85	1.65	1.15	1.1	1.15	1.4	1.2	1.2
9	2.15	1.45	2.2	2.75	1.8	1.6	1.15	1.15	1.15	1.35	1.3	1.15
10	2.0	1.5	2.15	2.7	1.75	1.55	1.1	1.1	1.15	1.3	1.0	1.15
11	1.95	1.5	2.2	2.6	1.7	1.7	1.2	1.05	1.15	1.3	1.2	1.1
12	1.8	1.45	2.25	2.5	1.7	1.85	1.2	1.05	1.15	1.3	1.2	1.1
13	1.8	1.45	2.25	2.45	1.7	1.9	1.2	1.25	1.1	1.25	1.3	1.15
14	1.75	1.45	2.25	2.4	1.65	1.85	1.1	1.25	1.1	1.25	1.2	1.1
15	1.65	1.45	2.4	2.35	1.65	1.7	1.1	1.2	1.1	1.25	1.15	1.1
16	1.6	1.45	2.6	2.35	1.6	1.5	1.1	1.15	1.1	1.25	1.25	1.1
17	1.6	1.5	2.9	2.4	1.7	1.45	1.1	1.15	1.15	1.3	1.25	1.1
18	1.6	1.65	3.0	2.4	1.7	1.45	1.05	1.15	1.15	1.35	1.2	1.15
19	1.55	1.8	3.3	2.5	1.8	1.45	1.05	1.1	1.1	1.4	1.2	1.15
20	1.55	1.7	3.6	2.6	1.9	1.45	1.0	1.1	1.1	1.5	1.15	1.15
21	1.5	1.6	3.7	2.65	1.95	1.45	1.0	1.1	1.1	1.45	1.15	1.1
22	1.5	1.55	3.7	2.6	1.9	1.45	1.0	1.1	1.15	1.4	1.2	1.2
23	1.5	1.5	3.7	2.6	1.85	1.45	.9	1.1	1.15	1.35	1.3	1.15
24	1.5	1.5	3.75	2.5	1.85	1.5	1.15	1.1	1.1	1.35	1.25	1.1
25	1.55	1.5	3.7	2.4	1.9	1.5	1.15	1.1	1.3	1.35	1.2	1.5
26	1.6	1.55	3.65	2.35	1.9	1.45	1.1	1.1	1.8	1.35	1.3	1.3
27	1.6	1.55	3.6	2.3	1.85	1.4	1.05	1.1	1.8	1.35	1.25	1.15
28	1.55	1.55	3.5	2.25	1.8	1.35	1.05	1.05	1.7	1.3	1.2	1.1
29	1.5	.....	3.5	2.2	1.8	1.3	1.0	1.05	1.6	1.3	1.3	1.1
30	1.5	.....	3.4	2.15	1.85	1.25	1.0	1.2	1.5	1.3	1.2	1.3
31	1.5	.....	3.35	.....	1.9	.....	1.0	1.2	.....	1.3	.....	1.25

NOTE.—Ice present Jan. 1–15 and also backwater effect at the gage during the latter part of December.

Daily discharge, in second-feet, of Kettle River near Sandstone, Minn., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	190	148	186	1,070	375	250	101	52	90	160	112	70
2	190	148	201	965	375	233	101	52	90	186	101	70
3	190	160	216	860	352	216	90	61	90	186	112	70
4	190	160	269	828	330	201	90	70	90	160	112	70
5	190	148	352	860	330	216	80	70	90	148	112	90
6	190	148	375	828	309	233	70	70	101	148	61	90
7	190	148	375	795	288	216	70	61	101	136	112	112
8	190	148	398	735	269	201	80	70	80	136	90	90
9	190	148	420	705	250	186	80	80	80	124	112	80
10	190	160	398	675	233	173	70	70	80	112	52	80
11	190	160	420	620	216	216	90	61	80	112	90	70
12	190	148	442	565	216	269	90	61	80	112	90	70
13	190	148	442	540	216	288	90	101	70	101	112	80
14	190	148	442	515	201	269	70	101	70	101	90	70
15	190	148	515	490	201	216	70	90	70	101	80	70
16	186	148	620	490	186	160	70	80	70	101	101	70
17	186	160	795	515	216	148	70	80	80	112	101	70
18	186	201	860	515	216	148	61	80	80	124	90	80
19	173	250	1,070	565	250	148	61	70	70	136	90	80
20	173	216	1,300	620	288	148	52	70	70	160	80	80

Daily discharge, in second-feet, of Kettle River near Sandstone, Minn., for 1910—Contd.

Date.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	160	186	1,370	648	309	148	52	70	70	148	80	70
22	160	173	1,370	620	288	148	52	70	80	136	90	90
23	160	160	1,370	620	269	148	36	70	80	124	112	80
24	160	160	1,410	565	269	160	80	70	70	124	101	70
25	173	160	1,370	515	288	160	80	70	112	124	90	160
26	186	173	1,330	490	288	148	70	70	250	124	112	112
27	186	173	1,300	465	269	136	61	70	250	124	101	80
28	173	173	1,220	442	250	124	61	61	216	112	90	70
29	160	.....	1,220	420	250	112	52	61	186	112	112	70
30	160	.....	1,140	398	269	101	52	90	160	112	90	112
31	160	.....	1,110	.....	288	.....	52	90	.....	112	.....	101

NOTE.—Discharges estimated for Jan. 1 to 15.

Monthly discharge of Kettle River near Sandstone, Minn., for 1910.

[Drainage area, 825 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	190	160	180	0.218	0.25	B.
February	250	148	164	.199	.21	A.
March	1,410	186	784	.950	1.10	A.
April	1,070	398	631	.765	.85	A.
May	375	186	269	.326	.38	A.
June	288	101	184	.223	.25	A.
July	101	36	71.1	.086	.10	A.
August	101	52	72.3	.088	.10	A.
September	250	70	104	.126	.14	A.
October	186	101	129	.156	.18	A.
November	112	52	95.9	.116	.13	A.
December	160	70	83.1	.101	.12	A.
The year	1,410	36	231	.278	3.81	

SNAKE RIVER.

GENERAL FEATURES OF AREA DRAINED.

Snake River, which drains an area lying southwest of Kettle River basin, rises in T. 45 N., R. 23 W., in Aitkin County and flows south and east into St. Croix River in T. 39 N., R. 19 W., in Pine County. Its chief tributaries are Knife, Ann, Groundhouse, and Little Snake rivers. The total area drained by the river is 948 square miles.

In its upper course the river flows through a wide shallow valley, but below Cross Lake the valley becomes deeper and narrower and the stream swifter, although it does not cut through the glacial drift into the underlying rock. The slightly undulating surface is covered with glacial red till, which rests on Archean granites, gneisses, and schists in the upper part of the basin, and on Cambrian sandstones and limestones in the southeastern part. Rock outcrops at various points along the upper river, notably at the upper and lower falls in the northern part of Kanabec County. The upper falls are two-

thirds of a mile below the mouth of Cowans Brook and are caused by granite outcrops on both banks of the river, which here flows between vertical walls for a distance of 10 rods, with a fall of about 3 feet. At the lower falls, which are located a short distance farther downstream, the river descends 20 feet in a distance of three-fourths of a mile. The upper part of the area is so flat that considerable tracts are swampy. The basin contains a dozen lakes, comprising less than 1 per cent of the total area.

The basin was originally densely forested, but is now for the most part covered with brush. Conditions are favorable for forest reproduction, as the fires which have occurred at various times have not seriously damaged the soil. Less than 25 per cent of the land is cleared.

The mean annual precipitation is about 29 inches, of which 3½ inches occurs as snow which remains during the winter. Except at rapids, the river freezes over during the winter. As there are no winter thaws, the flow is derived from the lakes and from ground water, and is therefore very uniform, decreasing gradually until midwinter, when it reaches a minimum.

The best reservoir site in the basin is Cross Lake, near Pine City, which has an area of several square miles. A dam at the outlet of this lake backs the water up Snake River for 15 miles, and also in Pokegama Lake, which is tributary to Snake River about 4 miles above Cross Lake. The reservoir thus formed is used for storage for a water-power plant at the outlet of Cross Lake, where a head of 17 feet is utilized. Small storage reservoirs, used in connection with log-driving, are also formed by logging dams at Knife Lake outlet and at White Pine.

The upper stretch of the river affords few water-power sites, but below Cross Lake the stream becomes a series of rapids, falling 147 feet in some 14 miles.

The following table has been compiled from various sources and shows the approximate water-surface elevation at different points.

Elevations and distances along Snake River.

Place.	Distance above mouth.	Elevation above sea level.
	Miles.	*Feet.*
St. Croix River	0	790
Sec. 19, T. 39 N., R. 20 W	9	900
Pine City (Cross Lake)	14	937
Foot Milletts rapids	30	938
Brunswick highway bridge	33	941
Mora	40	947
Highway bridge below Knife River	42	958
Sec. 6, T. 40 N., R. 23 W	50	1,000

SNAKE RIVER AT MORA, MINN.

This station, which is located at the highway bridge three-fourths of a mile south of Mora, in sec. 14, T. 39 N., R. 24 W., was established June 11, 1909, in connection with the general plan for investigating the water resources of Minnesota.

The nearest tributary, Ann River, enters 1 mile below the station. There are two logging dams above Mora—at Knife Lake outlet and at White Pine—but the operation of these dams has not seriously affected the gage heights since the station has been established. The only dam below Mora is at Cross Lake at Pine City and is too far distant to affect the river at Mora.

From December to March discharge measurements are made through the ice to determine the approximate winter flow.

Conditions at this station are excellent, and the records should therefore be reliable.

Discharge measurements of Snake River at Mora, Minn., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 13	G. A. Gray	96	125	[a] 6.90	59.8
Mar. 2	do	91	43.1	[b] 7.02	21.7
Apr. 2	do	105	236	7.34	316
June 22[c]	Robert Follansbee	60	40.1	5.60	35.4

[a] Gage height to water surface; thickness of ice, 0.73 foot.
[b] Gage height to water surface; thickness of ice, 1.52 feet.
[c] Wading measurement.

Daily gage height, in feet, of Snake River at Mora, Minn., for 1910.

[Mrs. Alice Lasher, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	6.90	7.40	6.20	5.78	5.60	5.65	6.65	5.70	5.68	.....
2	.....	6.90	7.00	7.32	6.16	5.78	5.60	5.62	6.65	5.65	5.65	5.95
3	.....	.....	.....	7.26	6.12	5.78	5.60	5.60	6.25	5.68	5.65	.....
4	.....	6.90	7.10	7.24	6.10	5.78	5.60	5.60	6.15	5.70	5.62	.....
5	6.80	.....	.....	7.28	6.06	5.79	5.60	5.60	6.02	5.68	5.60	.....
6	.....	.....	.....	7.25	6.02	5.90	5.60	5.55	5.92	5.65	5.62	6.00
7	6.90	.....	.....	7.11	6.00	5.90	5.62	5.60	5.88	5.62	5.75	.....
8	.....	6.80	7.00	7.04	6.00	5.88	5.61	5.60	5.80	5.60	5.65	.....
9	.....	.....	.....	6.92	5.96	5.85	5.68	5.60	5.80	5.60	5.70	6.00
10	.....	.....	.....	6.81	5.88	5.85	5.66	5.60	5.80	5.60	5.82	.....
11	6.90	6.80	7.10	6.81	5.80	5.80	5.62	5.60	5.75	5.60	6.00	.....
12	.....	.....	.....	6.65	5.78	5.78	5.68	5.60	5.70	5.62	5.80	.....
13	6.90	.....	7.20	6.55	5.78	5.75	5.60	5.72	5.70	5.60	5.75	6.00
14	6.90	.....	7.65	6.58	5.78	5.75	5.60	5.60	5.70	5.60	5.62	.....
15	.....	.....	8.30	6.48	5.76	5.75	5.60	5.60	5.65	5.60	5.50	.....
16	.....	6.70	8.65	6.40	5.76	5.75	5.60	5.60	5.60	5.60	5.70	6.20
17	.....	.....	8.35	6.54	5.82	5.70	5.62	5.66	5.60	5.60	.....	.....
18	6.90	.....	8.30	6.55	5.85	5.70	5.60	5.62	5.60	5.60	5.70	.....
19	.....	7.00	8.30	6.52	5.88	5.70	5.60	5.60	5.60	5.65	.....	.....
20	.....	.....	8.20	6.70	5.89	5.65	5.60	5.60	5.60	5.70	.....	6.12
21	6.90	.....	8.20	6.69	5.95	5.60	5.61	5.60	5.60	5.69	.....	.....
22	.....	7.00	8.10	6.65	6.00	5.60	5.61	5.60	5.60	5.65	5.85	.....
23	.....	.....	8.10	6.65	5.95	5.60	5.60	5.60	5.60	5.66	.....	6.22
24	.....	.....	8.15	6.58	5.90	5.60	5.68	5.60	5.60	5.65	.....	.....
25	.....	.....	8.20	6.50	5.90	5.60	5.65	5.60	5.60	5.64	5.80	.....
26	6.90	6.90	8.10	6.40	5.89	5.70	5.60	5.60	5.85	5.65	.....	.....
27	.....	.....	7.80	6.38	5.84	5.70	5.60	5.58	5.80	5.65	.....	6.40
28	.....	.....	7.80	7.16	5.80	5.70	5.60	6.80	5.80	5.65	.....	.....
29	6.90	.....	7.65	6.34	5.80	5.60	5.68	7.28	5.75	5.65	5.90	.....
30	.....	.....	7.55	6.22	5.80	5.60	5.65	7.30	5.70	5.65	.....	6.30
31	.....	.....	7.50	.....	5.79	.....	5.65	7.00	.....	5.65	.....	.....

NOTE.—Ice present from Jan. 1 to Mar. 16 and from Nov. 17 to Dec. 31.

Daily discharge, in second-feet, of Snake River at Mora, Minn., for 1910.

Day.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		20	345	96	49	36	40	167	43	42
2		22	321	91	49	36	37	167	39	40
3		25	304	86	49	36	36	103	42	40
4		30	298	83	49	36	36	90	43	37
5		30	309	78	50	36	36	73	42	36
6		35	301	73	60	36	33	62	39	37
7		40	264	71	60	37	36	58	37	47
8		70	247	71	58	37	36	51	36	40
9		100	219	67	56	42	36	51	36	43
10		150	197	58	56	40	36	51	36	53
11		150	197	51	51	37	36	47	36	71
12		200	167	49	49	42	36	43	37	51
13	a 60	300	150	49	47	36	45	43	36	47
14		500	155	49	47	36	36	43	36	37
15		715	138	48	47	36	36	40	36	30
16		890	125	48	47	36	36	36	36	43
17		740	148	53	43	37	40	36	36	.....
18		715	150	56	43	36	37	36	36	.....
19		715	144	58	43	36	36	36	39	.....
20		665	176	59	40	36	36	36	43	.....
21		665	174	66	36	37	36	36	42	.....
22		620	167	71	36	37	36	36	39	.....
23		620	167	66	36	36	36	36	40	.....
24		642	155	60	36	42	36	36	39	.....
25		665	141	60	36	40	36	36	39	.....
26		620	125	59	43	36	36	56	39	.....
27		490	122	55	43	36	35	51	39	.....
28		490	277	51	43	36	195	51	39	.....
29		431	116	51	36	42	309	47	39	.....
30		394	99	51	36	40	315	43	39	.....
31		377	.....	50	.....	40	237	.....	39	.....

a Discharge measurement.

NOTE.—Daily discharge computed from a well-defined rating curve, except for Mar. 1 to 14, when discharge is estimated.

Monthly discharge of Snake River at Mora, Minn., for 1910.

[Drainage area, 422 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	60.0	0.142	0.16	C.
February	.....	.....	35.0	.083	.09	D.
March	890	20	391	.927	1.07	C.
April	345	99	197	.467	.52	A.
May	96	48	62.4	.148	.17	A.
June	60	36	45.8	.109	.12	A.
July	42	36	37.5	.089	.10	A.
August	315	33	65.9	.156	.18	A.
September	167	36	56.6	.134	.15	B.
October	43	36	38.6	.091	.10	B.
November	71	.....	38.8	.092	.10	C.
December	.....	.....	18.0	.043	.05	D.
The year	.....	.....	87.2	.207	2.81	

NOTE.—Mean discharge estimated for January, February and December. Mean for Mar. 17 to 30 estimated at 33.5 second-feet.

CANNON RIVER.

GENERAL FEATURES OF AREA DRAINED.

Cannon River drains an area comprising 1,490 square miles, located chiefly in Goodhue, Rice, Le Sueur, and Steele counties, Minn. The river rises in Shields Lake, in the western part of Rice County, flows westward into Le Sueur County, then southward and eastward into Rice County again, passing through several lakes (the largest being 4 miles long and one-half to three-fourths mile wide) and finally taking a general northeasterly course to its junction with the Mississippi a short distance above Red Wing.

Cannon Lake, the last lake on the river, is several square miles in area. From Cannon Lake to Dundas the river flows through a narrow valley 40 to 50 feet below the general surface level. Below Dundas the valley widens and gradually deepens, but a few miles above Cannon Falls it again contracts, and it remains narrow and steep sided until it joins the Mississippi Valley, a few miles above the mouth. Throughout its length the river has considerable fall, much of which has been utilized by power dams.

The following drainage areas have been measured in the basin:

Drainage areas in Cannon River basin.

	Square miles.
Cannon River above Cannon Lake outlet	274
sec. line 27–34, T. 111 N., R. 20 W.	884
sec. 14, T. 112 N., R. 19 W.	1,020
sec. 10, T. 112 N., R. 17 W.	1,230
Welch	1,290
mouth	1,490
Straight River above mouth	443

In general the surface is undulating, but the lower part of the area is deeply cut by the gravel terraced river valleys.

Except in the valleys the area is covered with a red till—a glacial deposit consisting of a mixture of sand, clay, and gravel—which, in the upper part of the basin is underlain by Silurian and Cambrian sandstones, limestones, and shales, and in the lower part by Cambrian sandstones. The sandstones yield water to the many springs along the river. In the southern part of the area the red till gives way to a clay-loam soil.

The principal tributaries of the Cannon are Devil, Wolf, Heath, and Club creeks from the north, and Straight and Little Cannon rivers, and Belle, Hay, and Wells creeks from the south. Straight River, the most important of the tributaries, rises in lakes and springs scattered among the moranic hills in the southern part of the area, flows northward over the drift until it reaches a point about 2 miles north of Owatonna, where it first encounters bedrock, and joins the Cannon just below Cannon Lake.

The annual rainfall in the basin, as determined from a number of records exceeding 15 years in length, is about 29 inches. On this amount 4½ inches is precipitated in the form of snow which remains during the winter. The river is frozen over except at rapids, and as there are no winter thaws the flow is derived from the lakes and from ground water and is very uniform, reaching a minimum usually in about midwinter.

As the sides of the valley are very steep, the rainfall quickly reaches the stream and causes sudden rises which give the stream a somewhat flashy character. Otherwise, as much of the water comes from springs in sandstone, the flow is very uniform during the year.

As Cannon River lies in one of the most thickly settled farming sections of the State, by far the greater part of its drainage area is cultivated land.

The basin contains few lakes below Cannon Lake. Above that point are 25 lakes, lake surface forming about 10 per cent of the 274 miles of drainage area. Except Cannon Lake, which is already utilized as a reservoir in connection with power development, all the lakes are too far up on the headwaters to afford good reservoir sites.

In order to determine the availability of Cannon River for power development, a survey was made during 1909 from the mouth to Cannon Lake, a short distance above Faribault. From the data collected on this survey sheets have been prepared showing a profile of the water surface, a plan of the river, and the contours along the river bank. These sheets have been published separately and may be had on application to the district engineer, United States Geological Survey, Old Capitol Building, St. Paul, Minn. From this survey the following table of elevations and distances has been compiled:

Elevations and distances along Cannon River.

	Distance above mouth.	Elevation above sea level.
	Miles.	*Feet.*
Mississippi River	0	666
Chicago, Milwaukee & St. Paul Ry	4	673
Highway bridge	7	679
Range line 15–16 W	9	683
Belle Creek	11	690
Welch, tail-water	14	706
Welch, headwater	14	712
Range line, 16–17 W	18	730
Sec. 10, T. 112 N., R. 17 W	21	750
Pine Creek	23	758
Cannon Falls, tail-water	25	773
Cannon Falls, headwater	25	782
Goodhue Mill, tail-water	26	782
Goodhue Mill, headwater	26	797
Sec. 14, T. 112 N., R. 18 W	28	808
Prairie Creek	30	830
Chicago Great Western Ry	33	850
Wallace, tail-water	34	856
Wallace, headwater	34	866
Highway bridge	37	871
Do	38	876

Elevations and distances along Cannon River—Continued.

	Distance above mouth.	Elevation above sea level.
	Miles.	*Feet.*
Highway bridge	39	879
Waterford, tail-water	40	881
Waterford, headwater	40	888
Northfield, tail-water	42	888
Northfield, headwater	42	899
Dundas, tail-water	45	908
Dundas, headwater	45	917
Highway bridge	53	938
Do	54	941
Chicago, Rock Island & Pacific Ry	57	950
Faribault, tail-water	59	955
Faribault, headwater	59	963
Sheffield, tail-water	61	964
Sheffield, headwater (Cannon Lake)	61	978

Water power is developed at the following points in the drainage basin:

Developed water powers in Cannon River basin.

Place.	Fall utilized.	Average horsepower.
	Feet.	
Cannon Lake	14	300
Faribault	8	90
Dundas	10	125
Northfield	9	150
Waterford	7	150
Above Cannon Falls	58	2,600
Cannon Falls	9	225
Do	14	150
Welch	6	40
Owatonna, Straight River		40
Clinton Falls, Straight River	10	30

CANNON RIVER AT WELCH, MINN.

This station, which is located at the highway bridge at Welch, was established June 7, 1909, to determine the amount of water power available on the river.

The nearest important tributary, Belle Creek, enters 3 miles below Welch. A very small tributary enters the river just above the station.

About 800 feet above the bridge is a dam at which approximately 40 horsepower is developed. This dam leaks so badly that the operation of the turbine has little effect on the flow. The operation of this power plant, together with other plants farther upstream, causes considerable variation in the flow. The gage is read twice daily.

During the period from December to March ice is frequently gorged at the bridge, and reliable winter records are thereby made impossible.

Since the installation of the gage its datum has remained unchanged.

In April, 1888, the river reached the eaves of the wheel-house at the mill, a stage representing 20.1 feet above the datum of the present gage. It is stated locally that this rise was not caused by ice gorging. The angle made by the current at the gaging station necessitates a correction, and artificial control of the river causes daily fluctuation of stage; therefore the records can not be considered better than good.

Discharge measurements of Cannon River at Welch, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 7	G. A. Gray	97	448	6.70	637
July 16	....do..	87	270	5.55	224
Aug. 18	....do..	102	478	7.21	1,010
27	C. J. Emerson	91	355	6.06	385
Sept. 10	Robert Follansbee	93	382	6.32	426
Oct. 29	G. A. Gray	96	293	6.20	394
1910.					
Mar. 11	Robert Follansbee	113	632	8.85	1,850
Apr. 26	G. A. Gray	72	325	5.99	320
July 22	....do..	71	306	5.72	224
Sept. 19	Follansbee and Adams	73	242	5.14	96.5

Daily gage height, in feet, of Cannon River at Welch, Minn., for 1910.

[Miss E. J. Norell, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	7.12	6.15	5.80	5.69	5.20	5.32	5.42	5.00
2	.....	7.00	6.12	5.70	5.73	5.37	5.38	5.28	5.60
3	.....	7.02	5.75	5.75	5.58	5.16	5.20	5.28	5.18
4	.....	6.95	5.76	5.75	5.40	5.70	5.05	5.34	5.19
5	.....	6.92	5.68	6.38	5.60	5.46	5.18	5.08	5.28
6	.....	6.88	5.66	6.25	5.73	5.09	5.39	5.32	5.01
7	.....	6.50	5.65	5.80	5.54	5.06	5.32	5.32	5.32
8	.....	6.42	5.35	5.82	5.13	5.36	5.45	5.14	5.28
9	8.70	6.08	5.25	5.79	5.78	5.69	5.42	5.18	5.32
10	8.75	6.16	5.70	5.78	5.18	5.46	5.21	5.45	5.28
11	8.81	6.10	5.80	5.52	5.30	5.13	5.05	5.42	5.32
12	8.69	6.11	5.92	5.84	5.72	5.17	5.12	5.22	5.26
13	9.15	6.42	6.02	5.50	5.33	5.40	5.18	5.20	5.35
14	9.78	6.38	5.95	5.82	5.69	5.47	5.34	5.89	5.40
15	9.60	6.30	5.68	5.80	5.74	5.29	5.28	5.28	5.29
16	9.00	6.00	5.60	5.84	5.48	5.36	5.15	5.06	5.21
17	8.95	5.95	5.60	5.78	5.50	5.49	5.15	5.35	5.25
18	8.72	5.85	5.70	5.94	5.17	5.51	5.15	5.40	5.40
19	8.56	5.62	5.85	5.88	5.34	5.49	5.22	5.09	5.20
20	8.18	5.60	5.88	5.78	5.12	5.45	5.28	5.02	5.10
21	8.15	5.58	6.40	5.85	5.18	5.15	5.18	5.18	5.10
22	8.12	5.82	6.38	5.82	5.53	5.26	5.06	5.30	5.28
23	7.95	5.82	6.32	5.22	5.22	5.50	5.38	5.48	5.34
24	7.80	5.84	6.08	5.58	5.20	5.19	5.15	5.28	5.32
25	7.72	5.82	5.94	5.39	5.05	5.10	5.05	5.10	5.35
26	7.48	5.91	5.85	5.52	5.65	5.27	5.32	5.32	5.35
27	7.35	6.24	5.79	5.40	5.22	5.32	5.40	5.22	5.09
28	7.22	6.30	6.18	5.79	5.38	5.20	5.42	5.02	5.08
29	7.12	6.50	6.10	5.18	5.78	5.28	5.54	5.24	5.00
30	7.25	6.28	6.18	5.70	5.42	5.50	5.34	5.46	5.80
31	7.22	.....	5.80	.....	5.39	5.32	.....	5.10	.....

NOTE.—Ice present Jan. 1 to Mar. 8, and from Dec. 1 to 31.

Daily discharge, in second-feet, of Cannon River at Welch, Minn., for 1909–10.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1909.[a]								
1				495	245	272	407	606
2				453	245	276	383	2,160
3				453	308	250	517	2,020
4				394	272	512	272	1,570
5				308	182	489	403	1,020
6				308	182	403	437	701
7			683	278	245	445	371	667
8			658	264	200	480	399	667
9			609	200	200	526	411	639
10			562	250	237	471	517	489
11			539	308	224	437	558	467
12			539	324	725	1,190	620	620
13			585	358	735	1,970	634	1,500
14			609	340	2,470	1,020	634	2,350
15			633	340	3,660	825	554	2,220
16			633	264	3,320	667	512	2,100
17			658	302	1,860	696	467	1,980
18			735	308	869	454	454	2,200
19			658	196	935	463	480	2,210
20			539	189	924	445	363	2,090
21			495	284	995	445	355	1,850
22			495	293	544	667	449	1,520
23			495	278	530	995	445	1,530
24			453	168	453	891	449	1,430
25			453	200	417	775	454	1,250
26			453	149	390	687	403	1,320
27			375	278	375	582	437	1,530
28			375	229	327	403	411	1,550
29			413	394	311	411	407	1,530
30			453	421	324	344	395	1,500
31				394	308		403	
1910.[b]								
1	836	383	256	223	112	135	157	80
2	775	371	226	235	146	148	127	199
3	785	241	241	194	106	112	127	109
4	750	244	241	152	226	88	139	110
5	735	221	480	199	165	109	92	127
6	715	215	424	235	93	150	135	82
7	535	212	256	185	89	135	135	135
8	498	144	263	100	144	164	102	127
9	355	126	253	250	223	157	109	135
10	387	226	250	109	165	114	164	127
11	363	256	180	131	100	88	157	135
12	367	296	269	232	107	98	116	123
13	498	333	175	137	152	109	112	142
14	480	307	263	223	168	139	286	152
15	445	221	256	238	129	127	127	129
16	325	199	269	170	144	103	89	114
17	307	199	250	175	173	103	141	122
18	272	226	303	107	177	103	152	152
19	204	272	282	139	173	116	93	112
20	199	282	250	98	164	127	83	95
21	194	489	272	109	103	109	109	95
22	263	480	263	182	123	89	131	127
23	263	454	116	116	175	148	170	139
24	269	355	194	112	110	103	127	135
25	263	303	152	88	95	88	95	142
26	293	272	180	213	125	135	135	142
27	420	253	154	116	135	152	116	93
28	445	395	253	148	112	157	83	92
29	535	363	109	250	127	185	120	80
30	437	395	226	157	175	139	166	100
31		256		150	135		95	

[a] Daily discharge computed from two fairly well defined rating curves.
[b] Daily discharge computed from a rating curve that is well defined below 600 second-feet. Discharge on Nov. 30 is estimated.

Monthly discharge of Cannon River at Welch, Minn., for 1909–10.

[Drainage area, 1,290 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
June (7–30)	735	375	546	0.423	0.38	B.
July	495	149	304	.236	.27	B.
August	3,660	182	742	.575	.66	B.
September	1,970	250	616	.478	.53	B.
October	634	272	452	.350	.40	B.
November	2,350	46	1,440	1.12	1.25	D.
1910.						
April	836	194	440	.341	.38	B.
May	489	126	290	.225	.26	B.
June	480	109	244	.189	.21	B.
July	250	88	167	.129	.15	B.
August	226	89	141	.109	.13	B.
September	185	88	124	.096	.11	B.
October	286	83	129	.100	.12	B.
November	199	80	122	.095	.11	B.

CHIPPEWA RIVER.

GENERAL FEATURES OF AREA DRAINED.

The Chippewa River drainage system has its source in more than a hundred lakes, large and small, with many connecting swamps, lying in the northwestern part of Wisconsin, near the Michigan boundary and only 20 miles from Lake Superior. The main line of drainage runs very nearly along the central line of the basin, but the name Chippewa River is not applied to the continuation of the main stream. The river divides 112 miles from the mouth; one branch, the prolongation of the line of drainage, called the Flambeau, rises in the lakes near the Michigan line, at an elevation approximately 1,600 feet above sea level; the other branch, the Chippewa, is formed in the central part of Sawyer County by the union of East and West branches, both of which rise in the southwestern part of Ashland County. The course of the river is general southwestward to its junction with the Mississippi at the foot of Lake Pepin. The Flambeau drains about 1,983 square miles; the Chippewa above its junction with the Flambeau drains only about 1,777 square miles. The total length of the Chippewa is 267 miles. The drainage basin, which is regular in shape, is about 180 miles long and about 60 miles in average width, and comprises about 9,573 square miles, of which over 6,000 square miles include the most unsettled region of northern Wisconsin.

The important tributaries of the Chippewa are as follows: From the west (beginning at the sources), West Branch and Red Cedar rivers; from the east, East Branch, Thornapple, Flambeau, Jump, Yellow, and Eau Claire rivers.

The entire area above Chippewa Falls is covered with glacial drift, the underlying crystalline rocks appearing only in the river bed. In the southern part of the basin the rivers have cut deeply into the drift and rock, but in the northern districts they have not cut much below the surface. The country is level or rolling.

With few exceptions all the many and important water powers on Chippewa River are found in the region of crystalline rocks, but on account of the deep glacial drift the power sites on the upper streams occur at bowlder rapids.

The lakes in this drainage basin form two widely separated groups; one in the extreme northeastern part at the headwaters of the Flambeau, the other in the northwestern part at the headwaters of Chippewa and Red Cedar rivers. The remainder of the area is almost devoid of lakes. The wooded regions, however, include very large areas of cedar and tamarack swamps. The sources of Chippewa River have an elevation of about 1,500 feet above sea level; at Chippewa Falls the elevation is 806 feet; at the mouth of the river it is about 665 feet. The elevation of the sources of Flambeau River is about 1,650 feet; at Ladysmith the elevation is 1,115 feet.

This drainage basin contains the richest forests of both hard and soft woods still standing in Wisconsin. Although lumbering has been carried on actively for many years, considerable pine timber still remains, chiefly at the upper headwaters, but it is fast disappearing. The upper half of the drainage basin may be considered forested.

The mean annual rainfall is about 30 inches. The winters are severe. The snowfall is heavy and lasts for long periods; ice forms on the streams about 2 feet in thickness and remains for three to four months.

This drainage area affords an unusually large number of excellent sites for reservoirs. According to surveys made by the United States Engineer Corps in 1880, 12 reservoir sites were located and surveyed, whose total capacity was approximately 25,000,000,000 cubic feet. The highest dam necessary was about 26 feet. The operation of these reservoirs, it was estimated, would increase the ordinary low-water flow of the river by 3,245 second-feet for 90 days, thus about doubling the present available water power of the river. The main obstacle to building such reservoirs at the present time by the Government is the fact that, owing to the settling of this region, the land that would be flooded has become very valuable. Private enterprise has developed some of the smaller sites.

Several valuable developed water powers and many undeveloped power sites are located on this river and its tributaries. The Dells Paper & Pulp Co.'s mill, near Eau Claire, has a turbine plant of over 8,000 horsepower, and plans have been made to increase the head from 26 to 32 feet by increasing the height of the dam. On the Flambeau and Red Cedar exceptionally good power sites exist. Near

Ladysmith, on the Flambeau, are two plants, one of which has a rated turbine installation of 3,000 horsepower. In a 30-mile stretch of Red Cedar River there are six sites for water power capable of developing about 13,000 horsepower. The utilization of many of the power sites is retarded by the fact that the area is not now thickly settled and many sections lack railroad facilities.

The river and its tributaries are used extensively for running logs, but where railroads are accessible the logs are moved by rail. The extension of railroads in this section will tend to relieve the river of its burden of logs and add correspondingly to the value of the streams for water-power development.

The use of the river for flooding logs modifies the normal flow of the river very materially.

In order to determine the amount of power available along Flambeau River, a survey was made during 1906 from Flambeau to a point near the western border of Lac du Flambeau Indian Reservation; the section from the mouth to Flambeau had been surveyed by the Geological Survey in 1902. From the data collected sheets have been prepared showing a profile of the water surface, a plan of the river, contours along the bank, and prominent natural or artificial features. The results of this survey have been published on separate sheets, and may be had by applying to E. A. Birge, director, Wisconsin Geological and Natural History Survey, Madison, Wis.

From this study the folowing table of elevations and distances has been compiled:

Elevations and distances along Flambeau River.

Place.	Distance above mouth.	Elevation above sea level.
	Miles.	*Feet.*
Chippewa River	0	1,048
Section corner 10–14	4	1,057
Foot of Ducamon rapids	9	1,070
Head of Ducamon rapids	9.5	1,074
Section line 8–17	14	1,085
Foot of Ladysmith dam	20.5	1,098
Crest of Ladysmith dam	20.5	1,115
Section line 6–5	24	1,116
Foot of Little Falls rapids	29	1,133
Head of Little Falls rapids	29.5	1,141
Foot of Big Falls rapids	36	1,178
Head of Big Falls rapids	37	1,210
Section line 7–18	42	1,247
Sawyer-Rusk County line	47	1,289
Head of Flambeau Falls	51	1,298
Head of Porcupine rapids	55	1,317
Babs Island	63	1,340
Pine Creek	74	1,377
Section line 17–16	80	1,387
Section corner 12–14	86	1,413
Highway bridge section line 34–35	93.5	1,443
Foot of dam below Park Falls	95	1,447
Crest of dam below Park Falls	95	1,469
Foot of dam at Park Falls	97	1,482
Crest of dam at Park Falls	97	1,486
Section line 28–21	105.5	1,507
Ashland-Iron County line	111	1,516
Turtle River	115	1,547

CHIPPEWA RIVER AT CHIPPEWA FALLS, WIS.

This station is located at the highway bridge at Chippewa Falls, Wis. The gage was originally established by the Chippewa Lumber & Boom Co. in April, 1899. On June 1, 1906, the United States Geological Survey began taking discharge measurements at this place to determine the amount of water available for water power and storage. The United States Weather Bureau has obtained gage-height records for this station since 1904. The records for April to September, published herewith, were furnished by that bureau.

Duncan Creek is tributary on the right side about 2,500 feet above the station.

The datum of the staff gage has remained unchanged.

The winters are severe in this vicinity, and ice forms on the river about 2 feet in thickness; but owing to the swift water and the proximity of the dam considerable open water is found at the measuring section.

The normal flow of the stream is much modified by logging and by the power plants at Chippewa Falls, which cause great and rapid fluctuations in stage from day to day.

As the station was not visited during 1910 the estimates are withheld until checked by additional measurements.

Daily gage height, in feet, of Chippewa River at Chippewa Falls, Wis., for 1910.

[N. O. Swift, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.0	1.55	1.3	2.8	2.2	1.9	0.7	0.9	0.8	1.2	0.7	0.7
2	3.0	1.5	1.4	2.7	2.3	1.8	1.3	.6	1.0	1.1	.7	.7
3	2.95	1.4	1.3	2.5	1.9	1.8	.7	.7	1.1	1.1	.7	.6
4	2.9	1.35	1.4	2.4	1.8	3.8	.9	.8	.9	1.15	.7	.55
5	2.85	1.3	1.4	2.5	1.7	1.7	1.2	.9	.7	1.2	.7	.5
6	2.8	1.25	1.45	2.6	1.8	1.9	.7	.7	1.1	1.25	.7	.5
7	2.7	1.2	1.55	2.7	1.7	1.6	− .1	.0	1.6	1.2	.7	.55
8	2.7	1.2	1.6	2.6	1.6	1.5	− .2	.8	1.5	1.15	.7	.6
9	2.75	1.35	1.65	2.7	1.5	1.5	− .3	.7	1.2	1.1	.7	.55
10	2.85	1.35	1.75	2.3	1.4	1.4	− .4	.4	1.0	1.15	.7	.5
11	3.0	1.2	1.85	2.0	1.4	1.3	− .1	.5	.8	1.1	.7	.5
12	2.8	1.2	1.9	2.1	1.4	1.0	− .4	.0	1.2	1.15	.7	.5
13	2.6	1.4	1.9	1.9	1.3	1.2	− .5	.2	1.0	1.1	.7	.5
14	2.5	1.35	1.85	1.8	1.4	1.1	+1.0	.0	1.1	1.1	.65	.5
15	2.5	1.3	1.75	1.9	1.0	1.3	− .4	.2	1.2	1.1	.6	.5
16	2.4	1.3	1.7	1.8	1.3	1.0	− .5	.6	1.3	.55	.6	.5
17	2.4	1.25	1.55	1.6	1.4	1.2	− .7	.5	1.2	1.1	.6	.5
18	2.25	1.2	1.55	1.5	2.2	1.3	− .3	.7	.5	.5	.6	.5
19	2.05	1.2	1.8	2.1	3.5	1.0	− .4	.8	1.6	.65	.6	.6
20	1.95	1.3	2.0	2.4	4.0	1.3	− .5	.9	1.5	.8	.5	.7
21	1.7	1.3	2.25	3.9	3.6	1.1	− .6	.2	.4	.8	.5	.8
22	1.55	1.1	3.35	3.6	3.7	1.0	− .6	.3	.3	.6	.5	.7
23	1.5	1.15	3.3	3.2	3.8	.8	− .5	.7	1.0	.7	.5	.6
24	1.45	1.35	3.0	2.8	3.7	1.0	− .8	.6	.9	.7	.5	.7
25	1.45	1.4	3.45	2.9	3.5	1.1	− .1	.7	.5	.7	.5	.7
26	1.65	1.3	3.3	3.2	3.4	.7	+1.0	.6	1.2	.7	.5	.7
27	1.75	1.3	3.3	2.5	3.3	1.0	1.1	.5	.9	.7	.5	.6
28	1.8	1.4	3.0	2.6	3.0	1.0	1.2	.0	1.0	.7	.55	.6
29	1.7	.....	2.95	2.4	2.3	.8	1.1	.9	.9	.7	.6	.6
30	1.6	.....	3.05	2.5	1.2	.7	.8	1.0	1.0	.7	.65	.7
31	1.6	.....	2.95	.....	2.0	.....	.2	.9	.....	.7	.....	.7

NOTE.—Ice from Jan. 9 to Mar. 19.

RED CEDAR RIVER AT CEDAR FALLS, WIS.

This station, which is located at the highway bridge on the outskirts of Cedar Falls, Wis., was established in 1908 to replace the station at Menomonie, but gage heights were not obtained until April 1, 1909. The data collected at this station are used in studying water power, water supply, pollution, and storage problems.

No important tributaries enter Red Cedar River in the immediate vicinity of the gage.

Winters are severe in this locality, but the relation between gage height and discharge at the section does not appear to be much modified by ice, probably on account of the rapids a short distance below the station.

The datum of the staff gage has remained unchanged.

The observer at this station is paid by the Chippewa Valley Light & Power Co.

No discharge measurements have been made, and the station has not been visited since the gage was established. Therefore not much is known about existing conditions.

Daily gage height in feet of Red Cedar River at Cedar Falls, Wis., for 1910.

[Olaf Oas, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	2.7	2.2	2.4	2.0	2.0	2.0	2.6	1.6	1.9
2	.....	.....	.....	2.6	2.2	2.4	2.0	2.0	2.0	2.65	2.0	1.6
3	.....	3.7	4.9	2.6	2.2	2.4	2.0	2.0	2.0	2.8	2.0	1.7
4	.....	.....	.....	2.5	2.2	2.4	2.0	2.0	2.0	2.8	2.1	2.1
5	.....	.....	.....	2.5	2.2	2.4	2.0	2.0	2.0	2.8	2.2	2.3
6	3.8	.....	.....	2.5	2.3	2.4	2.0	2.0	2.0	2.8	2.2	2.2
7	.....	.....	.....	2.4	2.3	2.3	2.0	2.0	2.1	2.8	2.2	2.25
8	.....	.....	.....	2.4	2.3	2.3	2.0	2.0	2.1	2.8	2.2	2.2
9	.....	.....	.....	2.4	2.3	2.3	2.0	2.0	2.1	2.3	2.2	2.2
10	.....	3.8	5.0	2.4	2.3	2.3	2.0	2.0	2.1	2.9	2.2	2.2
11	.....	.....	.....	2.4	2.3	2.2	2.0	2.0	2.1	2.8	2.2	2.2
12	.....	.....	.....	2.4	2.2	2.2	2.0	2.0	2.1	2.7	1.7	2.15
13	3.7	.....	4.55	2.4	2.2	2.2	2.0	2.0	2.1	2.7	1.6	2.35
14	.....	.....	4.15	2.4	2.2	2.2	2.0	2.0	2.1	2.6	1.7	2.6
15	.....	.....	3.8	2.4	2.2	2.2	2.0	2.0	2.1	2.55	1.8	2.35
16	.....	.....	3.6	2.4	2.25	2.2	2.0	2.0	2.1	2.5	2.0	2.2
17	.....	3.9	3.55	2.4	2.4	2.2	2.0	2.0	2.0	2.5	2.0	2.1
18	.....	.....	3.4	2.4	2.55	2.2	2.0	2.0	2.0	2.3	1.4	2.0
19	.....	.....	3.4	2 4	2.75	2.2	2.0	2.0	2.0	2.3	1.8	2.0
20	3.6	.....	3.4	2.35	2.8	2.2	2.0	2.0	2.0	2.4	1.8	2.0
21	.....	.....	3.35	2.3	2.8	2.2	2.0	2.0	2.0	2.5	2.6	2.0
22	.....	.....	3.3	2.3	2.7	2.2	2.0	2.0	2.0	2.4	2.6	2.0
23	.....	.....	3.3	2.3	2.7	2.2	2.0	2.0	2.0	2.4	2.6	2.0
24	.....	4.0	3.2	2.3	2.65	2.2	2.0	2.0	2.0	2.4	2.5	2.0
25	.....	.....	3.2	2.3	2.6	2.1	2.0	2.0	2.05	2.3	2.45	2.0
26	.....	.....	3.05	2.3	2.55	2.1	2.0	2.0	2.4	2.3	2.4	2.0
27	3.7	.....	3.0	2.3	2.5	2.1	2.0	2.0	2.6	2.2	2.4	1.95
28	.....	.....	2.9	2.3	2.45	2.1	2.0	2.0	2.6	2.2	2.3	1.9
29	.....	.....	2.8	2.3	2.4	2.1	2.0	2.0	2.6	2.1	2.1	1.9
30	.....	.....	2.75	2.2	2.4	2.0	2.0	2.0	2.6	2.1	2.0	1.9
31	.....	.....	2.7	.....	2.4	.....	2.0	2.0	.....	2.1	.....	1.9

NOTE.—Ice present from Jan. 1 to Mar. 13, ranging in thickness from 11 to 16 inches.

ZUMBRO RIVER.

GENERAL FEATURES OF AREA DRAINED.

Zumbro River drains an area bounded by the Cannon River basin on the north and the basin of Root River on the south, and located chiefly in Wabasha, Goodhue, Dodge, and Olmstead counties in southeastern Minnesota. The North Branch of Zumbro River rises in the southeastern part of Rice County and flows eastward; the South Branch is formed by a number of small tributaries in the southwestern part of Olmstead County and flows northward, receiving throughout its course many tributaries, the largest being the Middle Branch. In the western part of Wabasha County the two streams unite to form the Zumbro, which takes a general easterly course until it reaches the flood plain of the Mississippi, where it empties into one of the sloughs of the region. The cut-off ditch connects it directly with the river.

The following drainage areas have been measured in the drainage basin:

Drainage areas in Zumbro River basin.

	Square miles.
Zumbro River above Zumbro Falls	1,120
Zumbro River above mouth	1,390
South Branch above mouth	821

The valleys of the North and South branches are cut 100 to 200 feet below the general level of the country and are bordered by bluffs. The valley of lower Zumbro River becomes deeper, and at the mouth of the river is 400 feet deep, and is bounded by rock cliffs, chiefly sandstone. The general width of the valley is 1 to 2 miles. The streams discharging into the Zumbro Valley at the present time deposit on the flood plain more material than the Zumbro itself can carry away, and the valley is being gradually filled up. A great many large springs issue from the bluffs along various streams, and there are many springs and marshes that form the sources of the headwater streams.

The region is in general a gently undulating prairie. Its extreme west end is covered with blue till, a glacial deposit consisting of a mixture of sand, clay, and gravel. Throughout the central part of the area the streams have cut through the till into the underlying limestones, sandstones, and shales of Silurian and Cambrian age. The lower section of the basin, especially below the mouth of the South Branch, is in the Driftless Area and is covered with a clay-loam soil.

Many springs rise from the sandstone strata along the streams. The underground supply from the sandstones is so important that the flow of Zumbro River, aside from sudden freshets, is more uniform than that of any river in Minnesota except the Root, and this despite the fact that its basin contains no lakes.

Very little forest remains in the basin of the Zumbro at the present time, as most of the land is under cultivation.

The annual precipitation is about 30 inches, of which 4½ inches is snow, which remains through the winter. Except at rapids the rivers freeze over from December to March. There are no winter thaws, and the flow, being derived from ground water, remains higher than that of the streams in other sections of the State.

Because of the complete absence of lakes and the general flatness of the uplands, reservoir sites can be obtained only within the valleys of the streams by building dams from bluff to bluff.

A survey of Zumbro River from its mouth to a point 6 miles up the South Fork above its mouth was made in 1911 by the Geological Survey. Sheets showing the results of the survey may be had on application to the district engineer, United States Geological Survey, Old Capitol Building, St. Paul, Minn.

Water power has been developed at the following points in the basin:

Developed water powers in Zumbro River basin.

Place.	Fall utilized.	Average horse-power.
Zumbro at Zumbrota	8	10
Zumbro at Forest Mills	11	25
Zumbro at Mazeppa	22	60
Zumbro at Jarretts	11	60
South Branch at Rochester	8	20
South Branch below Rochester	10	30
Middle Branch at Oronoco	15	150

Drainage work has been carried on to a considerable extent, about 34,000 acres, chiefly in Wabasha and Dodge counties, having been ditched.

The river is subject to sudden freshets, as the steep slopes of the valleys cause the rainfall to find its way into the streams quickly. The years of highest water were 1888 and 1908, when the river rose from 20 to 25 feet above low-water stage.

ZUMBRO RIVER AT ZUMBRO FALLS, MINN.

This station, which is located at the highway bridge at Zumbro Falls, was established June 8, 1909, to obtain data for use in studies of power, flood-prevention, and sewage-disposal problems.

The nearest tributary, the South Branch, enters the river about 8 miles above the station. The nearest dam is at Jarretts, but the fall of the river between the two points is so great that the effect of the dam does not extend to the station.

Owing to the rapids a short distance above the station and also to springs the river is open practically throughout the year from the rapids for a distance of several miles downstream. For this reason

the daily gage readings are continued during the winter months. A discharge measurement made in February, 1910, gave a result about 15 per cent less than that indicated by the open-season rating curve. However, owing to the manner in which the measurement was made, it is probable that this discrepancy was largely caused by the freezing of the meter. The flow for the winter months has been computed by reducing the open-season rating curve for corresponding gage heights by 5 per cent.

The high water of June, 1908, is marked by a spike in a telegraph pole near the railroad station at Zumbro Falls. This is at an elevation of 26.7 feet above the datum of the gage. The high water of April, 1888, reached an approximate stage of 29.7 feet, as shown by a mark not so well defined as that of the 1908 flood.

Since the installation of the gage its datum has remained unchanged.

Conditions at this station are good and the records of flow should be reliable.

Discharge measurements of Zumbro River at Zumbro Falls, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 8	G. A. Gray	129	279	6.30	618
July 15	Gray and Gibson	129	185	5.52	270
Aug. 26	C. J. Emerson	129	228	5.69	319
Oct. 22	G. A. Gray	129	197	5.50	281
1910.					
Feb. 15	G. A. Gray	130	209	5.68	286
Mar. 10	Robert Follansbee	134	576	8.60	[a] 1,720
Apr. 27	G. A. Gray	129	220	5.75	344
July 21	....do	128	143	5.10	164
Sept. 20	Robert Follansbee	127	138	5.00	157

[a] Possible backwater from ice gorging.

Daily gage height, in feet, of Zumbro River at Zumbro Falls, Minn., for 1910.

[A. H. Sugg, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.76	5.56	6.15	5.60	5.48	5.18	5.00	5.16	5.06	5.12	5.04
2	.....	5.79	5.55	6.10	5.58	5.46	5.18	5.08	5.12	5.06	5.10	5.08
3	.....	5.78	5.65	6.10	5.60	5.42	5.17	5.08	5.08	5.06	5.10	5.11
4	.....	5.72	5.70	6.06	5.54	5.43	5.16	5.00	5.07	5.06	5.10	5.05
5	.....	5.64	5.98	5.95	5.54	5.40	5.13	5.00	5.10	5.06	5.10	5.08
6	.....	5.68	7.12	5.90	5.55	5.42	5.18	5.00	5.13	5.06	5.10	5.05
7	5.96	5.70	9.55	5.90	5.54	5.39	5.16	5.00	5.13	5.06	5.10	5.08
8	6.00	5.75	9.65	5.89	5.51	5.39	5.16	5.00	5.10	5.01	5.10	4.92
9	5.98	.....	9.25	5.81	5.50	5.38	5.17	5.00	5.07	5.00	5.09	5.05
10	5.96	.....	8.68	5.80	5.50	5.38	5.13	5.00	5.07	5.00	5.09	5.05
11	5.98	5.64	8.65	5.80	5.48	5.38	5.10	5.02	5.10	5.02	5.08	4.98
12	5.88	5.66	8.55	5.78	5.50	5.37	5.16	5.06	5.02	5.02	5.10	4.98
13	5.81	5.62	9.52	5.76	5.50	5.34	5.14	5.08	5.08	5.02	5.06	5.00
14	5.80	5.64	9.77	5.71	5.50	5.33	5.13	5.08	5.08	5.00	5.12	5.02
15	5.79	5.65	8.82	5.75	5.49	5.32	5.12	5.10	5.08	5.00	5.10	5.02
16	5.80	5.61	8.28	5.71	5.46	5.30	5.12	5.18	5.08	5.00	5.10	5.04
17	5.80	5.59	7.92	5.74	5.68	5.32	5.14	5.40	5.07	4.99	5.12	5.06
18	5.79	5.60	7.65	5.71	5.74	5.32	5.07	5.38	5.03	4.99	5.14	5.04
19	5.79	5.59	7.52	5.72	5.75	5.29	5.09	5.38	4.99	5.06	5.15	5.04
20	5.84	5.55	7.52	5.72	5.74	5.23	5.13	5.30	5.02	5.08	5.12	5.01

Daily gage height, in feet, of Zumbro River, at Zumbro Falls, Minn., for 1910—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	5.84	5.54	7.52	5.70	5.72	5.27	5.08	5.20	5.00	5.10	5.08	5.04
22	5.80	5.54	7.34	5.70	5.84	5.26	5.08	5.18	5.06	5.10	5.05	5.05
23	5.80	5.49	7.14	5.69	5.90	5.22	5.08	5.18	5.06	5.10	5.09	5.05
24	5.78	5.50	7.04	5.64	5.88	5.24	5.05	5.16	5.08	5.05	5.11	5.04
25	5.70	5.50	6.85	5.66	5.79	5.22	5.00	5.17	5.03	5.04	5.08	5.01
26	5.71	5.49	6.72	5.70	5.69	5.22	5.04	5.10	5.08	5.05	5.04	5.00
27	5.72	5.45	6.56	5.72	5.65	5.18	5.02	5.10	5.08	5.04	5.05	5.02
28	5.74	5.48	6.49	5.70	5.60	5.18	5.05	5.10	5.08	5.09	5.02	5.04
29	5.78	.....	6.38	5.68	5.54	5.18	5.05	5.09	5.10	5.02	5.00	5.05
30	5.75	.....	6.30	5.62	5.51	5.19	5.04	5.10	5.09	5.04	4.65	5.05
31	5.75	.....	6.21	.....	5.50	.....	5.02	5.12	.....	5.08	.....	5.05

NOTE.—Ice present Jan. 1–6. Gage heights slightly affected by ice in December.

Daily discharge, in second-feet, of Zumbro River at Zumbro Falls, Minn., for 1909–10.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1	.....	.....	.....	.....	.....	.....	465	196	242	271	271	1,100
2	.....	.....	.....	.....	.....	.....	405	196	242	268	765	1,020
3	.....	.....	.....	.....	.....	.....	425	196	242	265	760	1,060
4	.....	.....	.....	.....	.....	.....	425	189	242	253	656	1,190
5	.....	.....	.....	.....	.....	.....	349	189	242	253	539	1,000
6	.....	.....	.....	.....	.....	.....	349	185	233	253	453	652
7	.....	.....	.....	.....	.....	.....	314	179	233	250	405	524
8	.....	.....	.....	.....	.....	575	297	213	233	242	382	520
9	.....	.....	.....	.....	.....	530	281	223	233	248	360	520
10	.....	.....	.....	.....	.....	485	265	242	239	259	331	520
11	.....	.....	.....	.....	.....	508	265	840	239	304	375	515
12	.....	.....	.....	.....	.....	530	281	1,460	765	397	710	510
13	.....	.....	.....	.....	.....	508	265	1,140	970	331	1,270	510
14	.....	.....	.....	.....	.....	445	281	1,460	715	321	2,400	510
15	.....	.....	.....	.....	.....	445	262	1,710	715	311	4,000	510
16	.....	.....	.....	.....	.....	405	250	2,040	584	294	2,500	510
17	.....	.....	.....	.....	.....	445	248	1,140	566	278	1,770	510
18	.....	.....	.....	.....	.....	598	248	890	521	265	1,300	500
19	.....	.....	.....	.....	.....	530	253	775	485	265	1,200	524
20	.....	.....	.....	.....	.....	508	248	598	386	265	1,120	540
21	.....	.....	.....	.....	.....	386	239	375	375	265	1,120	567
22	.....	.....	.....	.....	.....	405	215	375	375	271	1,270	549
23	.....	.....	.....	.....	.....	1,110	213	425	397	265	1,080	540
24	.....	.....	.....	.....	.....	740	220	324	413	259	926	504
25	.....	.....	.....	.....	.....	715	213	304	425	250	895	476
26	.....	.....	.....	.....	.....	598	201	338	413	253	905	444
27	.....	.....	.....	.....	.....	642	208	324	375	250	1,490	460
28	.....	.....	.....	.....	.....	642	201	324	324	239	1,900	456
29	.....	.....	.....	.....	.....	598	201	328	236	236	1,520	420
30	.....	.....	.....	.....	.....	575	201	291	177	239	1,240	428
31	.....	.....	.....	.....	.....	.....	196	271	.....	236	.....	440
1910.												
1	435	331	269	508	297	259	183	150	179	160	171	157
2	430	342	266	485	291	253	183	164	171	160	167	164
3	425	338	296	485	297	242	181	164	164	160	167	169
4	420	318	311	469	278	245	179	150	162	160	167	158
5	415	292	412	425	278	236	173	150	167	160	167	164
6	410	305	981	405	281	242	183	150	173	160	167	158
7	405	311	2,300	405	278	233	179	150	173	160	167	164
8	420	328	2,360	401	268	233	179	150	167	152	167	136
9	412	316	2,140	371	265	231	181	150	162	150	165	158
10	405	304	1,840	367	265	231	173	150	162	150	165	158
11	412	292	1,820	367	259	231	167	153	167	153	164	147
12	374	299	1,770	360	265	228	179	160	153	153	167	147
13	349	286	2,290	353	265	220	175	164	164	153	160	150
14	345	292	2,440	335	265	218	173	164	164	150	171	153
15	342	296	1,920	349	262	215	171	167	164	150	167	153

Daily discharge, in second-feet, of Zumbro River at Zumbro Falls, Minn., for 1909–10— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910.												
16	345	283	1,620	335	253	210	171	183	164	150	167	157
17	345	277	1,420	345	324	215	175	236	162	148	171	160
18	342	280	1,270	335	345	215	162	231	155	148	175	157
19	342	277	1,200	338	349	208	165	231	148	160	177	157
20	359	266	1,200	338	345	194	173	210	153	164	171	152
21	359	263	1,200	331	338	203	164	187	150	167	164	157
22	345	263	1,100	331	382	201	164	183	160	167	158	158
23	345	249	992	328	405	192	164	183	160	167	165	158
24	338	252	937	311	397	196	158	179	164	158	169	157
25	311	252	840	317	363	192	150	181	155	157	164	152
26	314	249	775	331	328	192	157	167	164	158	157	150
27	318	239	695	338	314	183	153	167	164	157	158	153
28	326	247	660	331	297	183	158	167	164	165	153	157
29	338	.....	611	324	278	183	158	165	167	153	150	158
30	328	.....	575	304	268	185	157	167	165	157	90	158
31	328	.....	534	.....	265	.....	153	171	.....	164	.....	158

NOTE.—Daily discharge computed from a rating curve that is well defined below 500 second-feet, but somewhat uncertain above. Discharges estimated for December, 1909, and Jan. 1 to 6 and Nov. 30, 1910.

Monthly discharge of Zumbro River at Zumbro Falls, Minn., for 1909–10.

[Drainage area, 1,120 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
June (8–30)	1,110	386	562	0.502	0.43	A.
July	465	196	274	.245	.28	A.
August	2,040	179	572	.511	.59	A.
September	970	177	395	.353	.39	A.
October	397	236	270	.241	.28	A.
November	4,000	271	1,130	1.01	1.13	B.
December	1,190	420	598	.534	.62	B.
1910.						
January	435	311	367	.328	.38	B.
February	342	239	287	.256	.27	B.
March	2,440	266	1,190	1.06	1.22	C.
April	508	304	367	.328	.37	A.
May	405	253	302	.270	.31	A.
June	259	183	216	.193	.22	A.
July	183	150	169	.151	.17	A.
August	236	150	172	.154	.18	A.
September	179	148	163	.146	.16	A.
October	167	148	157	.140	.16	A.
November	177	.....	163	.146	.16	A.
December	169	147	156	.139	.16	A.
The year	2,440	.....	309	.276	3.76	

ROOT RIVER.

GENERAL FEATURES OF AREA DRAINED.

Root River, which joins the Mississippi about 3 miles below La Crosse, drains an area including the extreme southeastern portion of Minnesota and a very small area, not exceeding a few square miles, in northeastern Iowa. The North Branch, which is the principal tributary, rises in the southeastern part of Dodge County and flows

in a general easterly course, being joined by the Middle Branch a few miles below Chatfield and by the South Branch near Lanesboro. Rush Creek enters the main stream near Rushford, and Money Creek and South Root River near Houston.

The North Branch flows to its junction with the Middle Branch through a cultivated valley one-half mile in average width and from 50 to 100 feet below the general surface level. Below the Middle Branch nearly to the mouth of the South Branch near Lanesboro, the valley is narrow and gorgelike, being cut 200 feet or more below the general level. The little bottom land there is in this section is under cultivation. Below the junction with the South Branch the Root flows through a narrow, steep-sided valley, in average width a quarter of a mile, until it reaches Peterson, below which, for the remainder of the course of the stream, the valley spreads out to an average width of three-quarters of a mile, and the bordering bluffs rise 300 to 500 feet above the bottom land. Nearly all the bottom land is under cultivation.

The fall of the North Branch is heavy from the head of the stream to its junction with the South Branch, below which the slope gradually decreases until it practically disappears a short distance above the mouth. The immediate banks of the river are 5 to 15 feet high. The following drainage areas have been measured in the basin:

Drainage areas in Root River basin.

	Square miles.
North Branch above sec. 8, T. 104 N., R. 11 W.	291
North Branch above junction with South Branch	647
Root River above sec. 4 , T. 103 N., R. 9 W.	940
Root River above Houston (above South Root River)	1,560
Root River above mouth	1,660

The region drained is an undulating plateau whose uplands range in altitude from 1,100 to 1,300 feet above sea level. The headwater areas are covered with till, a glacial deposit consisting of a mixture of sand, clay, and gravel, but the greater part of the basin lies in the Driftless Area and is covered with a soil of clay loam or "loess loam." In the Driftless Area the Root and its fanlike tributaries occupy valleys cut through limestones and sandstones of Silurian and Cambrian age. The sandstone beds are all strong water bearers, and to them are due the many springs that issue along the bluffs. The quantity of water reaching the river from these sandstones is so great that the flow of Root River, aside from its sudden freshets, is more uniform than that of any other river in Minnesota, despite the fact that the basin contains no lakes. During the exceedingly dry year of 1910 and early part of 1911, the flow of the Root diminished proportionately less than that of any other river in the State.

By far the greater part of the region drained by the Root is under cultivation, the forested areas being chiefly on the sides of the bluffs.

The annual precipitation for the basin, as shown by a number of records exceeding 10 years in length, is about 32 inches, 5 inches falling as snow, which remains during the winter months. Except at rapids the streams freeze over from December to March. There are no winter thaws, but the ground-water supply prevents the winter flow from falling as low as that of the streams in other portions of the State.

As the basin contains no lakes, reservoirs can be formed only by building dams from bluff to bluff across the gorgelike valleys. One good site of this type is found on the North Branch a short distance above the South Branch.

In order to determine the availability of Root River for power development, a survey was made during 1910 from the mouth to Orion Mill, a point on the North Branch several miles above Chatfield. From the data collected on this survey sheets have been prepared showing a profile of the water surface, a plan of the river, and the contours along the river bank. These sheets have been published separately and may be had upon application to the district engineer, United States Geological Survey, Old Capitol Building, St. Paul, Minn. From this survey the following table of elevations and distances has been compiled:

Elevations and distances along Root River.

Place.	Distance above mouth.	Elevation.
	Miles.	*Feet.*
Mississippi River	0	633
Chicago, Milwaukee & St. Paul Ry	4	635
Do	6	636
Thompson Creek	8	640
Hokah	11	645
Mound Prairie	18	655
Crystal Creek	21	659
Silver Creek	23	662
South Root River	27	669
Money Creek	31	680
Chicago, Milwaukee & St. Paul Ry	34	686
Rushford, tail-water	44	710
Rushford, headwater	47	725
Peterson	52	734
Whalen	62	768
South Branch Root River	66	784
Money Creek	77	856
Trout Creek	81	873
Highway bridge	91	913
Middle Branch Root River	94	927
Chatfield dam, tail-water	94	925
Chatfield dam, headwater	95	939
Chatfield	98	951
Highway bridge	103	990
Orion Mill, tail-water	107	1,018

Water power is developed at the following points in the drainage basin:

Developed water powers in Root River basin.

Place.	Fall utilized.	Average horsepower.
	Feet.	
At Stewartville	13	60
At Simpson		50
At Orion	8	20
Near Chatfield	14	65
At Preston	8	40
At Lanesboro	28	130
At Rushford	12	150
Do		50

Root River is subject to sudden freshets, as the steep slopes of the valleys cause the rainfall to find its way into the streams quickly. When in flood the river inundates large portions of the lands in the lower valley. So frequent have been these inundations that a considerable portion of the bottom land is not under cultivation.

ROOT RIVER NEAR HOUSTON, MINN.

This station, which is located at the first highway bridge 1 mile below Houston, in sec. 34, T. 104 N., R. 6 W., was established May 28, 1909, to obtain data for use in connection with water-power development and studies of flood prevention and sewage disposal.

The nearest tributary, South Root River, enters 1 mile below the bridge. Although this is ordinarily an insignificant stream, during heavy rains it overflows its banks and floods a considerable area.

There is no dam below, and the nearest one above it is at Rushford. As the flow of the river is at all times ample for the power generated at that point, it is not held back during certain portions of the day and thus has no influence on gage heights at Houston.

The river is icebound from December to March, and during that period discharge measurements are made through the ice to determine the approximate winter flow.

Discharge measurements are made from the bridge at which the staff gage is located. Since the establishment of the gage its datum has remained unchanged.

The channel scours out during floods and gradually fills in afterward, and for this reason it is necessary to make more frequent measurements than at other sections. The estimates based on the measurements can probably not be considered better than fair, or possibly good, except during low stages, when no change occurs.

Discharge measurements of Root River near Houston, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 28	J. C. Hoyt	105	302	1.50	615
June 18	G. A. Gray	103	273	1.30	540
18	C. B. Gibson	103	279	1.30	530
July 14	G. A. Gray	102	240	.92	424
Aug. 26	Robert Follansbee	105	424	1.76	605
Sept. 11	do	104	290	1.11	426
Nov. 11	G. A. Gray	105	288	1.45	596
1910.					
Feb. 10	G. A. Gray	105	279	[a]2.45	464
Apr. 29	do	105	279	1.58	482
June 24	Robert Follansbee	104	233	1.20	363
Sept. 21	do	104	197	1.10	333

[a] Gage height to water surface; thickness of ice, 0.92 foot.

Daily gage height, in feet, of Root River near Houston, Minn., for 1910.

[Olof Larson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	2.08	1.51	1.48	1.11	1.02	1.52	1.16	1.14	.....
2	.....	.....	.....	2.02	1.51	1.48	1.13	.96	1.35	1.12	1.15	.....
3	2.75	2.45	2.65	1.98	1.49	1.42	1.10	.98	1.25	1.18	1.18	.....
4	.....	.....	.....	1.98	1.48	1.42	1.08	.92	1.20	1.11	1.12	.....
5	.....	.....	.....	2.20	1.48	1.40	1.10	.92	3.15	1.15	1.12	1.92
6	2.60	.....	.....	1.98	1.45	1.41	1.04	.92	3.50	1.11	1.15	.....
7	.....	2.30	6.10	1.90	1.44	1.39	1.08	.90	2.18	1.15	1.10	.....
8	.....	.....	.....	1.82	1.44	1.35	1.06	.98	1.82	1.08	1.15	1.45
9	.....	.....	.....	1.82	1.44	1.34	1.06	.98	1.60	1.05	1.12	.....
10	.....	2.35	6.30	1.78	1.39	1.34	1.04	.98	1.46	1.10	1.12	.....
11	2.70	.....	4.28	1.78	1.38	1.35	1.10	.95	1.38	1.09	1.12	.....
12	.....	.....	3.96	1.72	1.38	1.31	1.05	.98	1.36	1.08	1.12	1.72
13	2.72	.....	4.28	1.71	1.38	1.31	1.05	1.12	1.29	1.08	1.09	.....
14	.....	2.40	4.85	1.70	1.38	1.30	1.06	1.30	1.28	1.08	1.15	.....
15	.....	.....	4.68	1.70	1.34	1.29	1.08	1.22	1.25	1.08	1.18	.....
16	.....	.....	4.08	1.71	1.39	1.28	1.05	1.18	1.18	1.08	1.15	1.80
17	2.80	2.20	3.55	1.70	1.64	1.28	1.16	1.25	1.12	1.12	1.12	.....
18	.....	.....	3.34	1.76	1.55	1.25	1.11	1.46	1.19	1.12	1.10	.....
19	.....	.....	3.20	1.70	1.59	1.22	1.04	1.32	1.18	1.09	1.12	.....
20	2.75	.....	3.20	1.68	1.58	1.20	1.02	1.25	1.16	1.12	1.12	1.80
21	.....	2.35	3.16	1.68	1.75	1.20	1.00	1.16	1.15	1.16	1.18	.....
22	.....	.....	3.12	1.65	3.15	1.24	1.06	1.20	1.12	1.14	1.15	.....
23	.....	.....	3.02	1.62	2.08	1.20	1.00	1.10	1.15	1.15	1.08	.....
24	.....	2.30	2.85	1.60	1.94	1.19	1.05	1.10	1.22	1.16	1.18	1.90
25	2.50	.....	2.78	1.65	1.85	1.21	1.00	1.10	1.29	1.15	1.15	.....
26	.....	.....	2.60	1.65	1.78	1.20	1.04	1.10	1.26	1.12	1.15	1.90
27	.....	2.45	2.49	1.61	1.70	1.21	.98	1.10	1.34	1.10	1.16	.....
28	2.55	.....	2.40	1.59	1.65	1.25	.98	1.02	1.21	1.15	1.15	.....
29	.....	.....	2.30	1.59	1.58	1.15	.99	.98	1.20	1.12	1.10	2.00
30	.....	.....	2.21	1.56	1.58	1.15	.96	1.18	1.18	1.10	1.02	.....
31	2.40	.....	2.12	.....	1.52	.....	.94	1.70	.....	1.09	.....	.....

NOTE.—Ice present from Jan. 1 to Mar. 9, and from Dec. 1 to 31.

Daily discharge, in second-feet, of Root River near Houston, Minn., for 1909–10.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1909.										
1					575	730	371	440	440	554
2					575	615	385	432	440	583
3					557	547	365	470	435	575
4					682	505	375	465	450	583
5					755	490	365	442	430	651
6					970	475	365	439	425	591
7					849	475	365	430	425	540
8					730	451	355	425	425	526
9					682	460	365	425	425	505
10					660	547	365	455	440	487
11					651	475	1,780	425	440	615
12					615	460	1,410	550	450	637
13					583	440	1,260	505	450	850
14					568	420	5,600	655	440	1,930
15					540	420	2,500	840	440	3,800
16					533	420	1,900	780	435	4,050
17					557	400	1,290	760	457	1,930
18					547	400	1,050	710	435	1,410
19					523	395	1,000	625	432	1,150
20					490	385	930	600	435	1,040
21					490	385	715	475	443	1,000
22					490	395	650	530	440	1,070
23					475	385	614	505	420	1,200
24					505	379	600	500	432	1,020
25					547	375	605	480	432	920
26					512	375	565	465	432	880
27					765	379	534	465	425	1,650
28				615	745	385	512	458	425	1,840
29				615	705	379	482	458	420	1,150
30				607	942	379	465	450	425	1,000
31				583	.....	375	460	.....	430	.....
1910.										
1	.....	430	686	458	448	338	315	462	350	345
2	.....	430	659	458	448	342	300	405	340	348
3	.....	450	641	452	427	335	305	375	355	355
4	.....	460	641	448	427	330	290	360	337	340
5	.....	500	740	448	420	335	290	1,270	348	340
6	.....	1,000	641	438	424	320	290	1,500	337	348
7	.....	2,500	605	434	417	330	285	731	348	335
8	.....	2,500	573	434	405	325	305	573	330	348
9	.....	2,000	573	434	402	325	305	490	322	340
10	[a] 464	1,800	557	417	402	320	305	441	335	340
11	.....	1,600	557	414	405	335	298	414	332	340
12	.....	1,380	533	414	393	322	305	408	330	340
13	.....	1,560	529	414	393	322	340	387	330	332
14	.....	1,900	525	414	390	325	390	384	330	348
15	.....	1,790	525	402	387	330	366	375	330	355
16	.....	1,450	529	417	384	322	355	355	330	348
17	.....	1,180	525	504	384	350	375	340	340	340
18	.....	1,080	549	472	375	338	441	358	340	335
19	.....	1,020	525	486	366	320	396	355	332	340
20	.....	1,020	518	483	360	315	375	350	340	340
21	.....	1,000	518	545	360	310	350	348	350	355
22	.....	985	508	1,270	372	325	360	340	345	348
23	.....	945	497	686	360	310	335	348	348	330
24	.....	879	490	623	358	322	335	366	350	355
25	.....	853	508	585	363	310	335	387	348	348
26	.....	789	508	557	360	320	335	378	340	348
27	.....	760	494	525	363	305	335	402	335	350
28	.....	734	486	508	375	305	315	363	348	348
29	.....	703	486	483	348	308	305	360	340	335
30	.....	730	476	483	348	300	355	355	335	315
31	.....	700	.....	462	.....	295	525	.....	332	.....

[a] Discharge measurement.

NOTE.—Daily discharge computed from a well-defined rating curve. High water estimates based on 1911 measurements.

Monthly discharge of Root River near Houston, Minn., for 1909–10.

[Drainage area, 1,560 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
June	970	475	627	0.402	0.45	A.
July	730	375	442	.283	.33	B.
August	5,600	355	933	.598	.69	B.
September	840	425	522	.335	.37	B.
October	457	420	435	.279	.32	B.
November	4,050	487	1,160	.744	.83	C.
December	.....	.....	*a* 600	.385	.44	C.
1910.						
January	.....	.....	*a* 500	.321	.37	B.
February	.....	.....	*a* 450	.288	.30	B.
March	2,500	430	1,130	.724	.83	C.
April	740	476	553	.354	.40	B.
May	1,270	402	502	.322	.37	A.
June	448	348	389	.249	.28	A.
July	350	295	322	.206	.24	A.
August	525	285	339	.217	.25	A.
September	1,500	340	466	.299	.33	A.
October	355	322	339	.217	.25	A.
November	355	315	343	.220	.25	A.
December	.....	.....	*a* 310	.199	.23	B.
The year	2,500	.....	470	.301	4.10	

a Estimated.

NORTH BRANCH OF ROOT RIVER NEAR LANESBORO, MINN.

This station, which is located at the Casey highway bridge, 2½ miles northeast of Lanesboro and 1 mile above the junction with the South Branch, in sec. 6, T. 103 N., R. 9 W., was established January 30, 1910.

There are no tributaries for a distance of several miles above the station.

The nearest dam is located above the Middle Branch 28 miles above, and its operation has no appreciable effect on the flow at the gaging station.

The drainage area above this station is 647 square miles.

A chain gage is attached to the highway bridge from which discharge measurements are made.

At a distance of 1,000 feet back from the right bank there is an old channel through which the river formerly discharged. At a stage of 6 feet on the gage the river begins to flow in this channel. An extreme flood stage the right bank will be overflowed for a width of one-fourth mile.

As the station has not been established sufficiently long to be completely rated no estimates of flow have been made, and only the base data are given.

Discharge measurements of North Branch of Root River near Lanesboro, Minn., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 29	G. A. Gray	103	252	2.28	191
June 24	Robert Follansbee	100	225	2.09	134
Sept. 21	.....do	100	225	2.09	136

Daily gage height, in feet, of North Branch of Root River near Lanesboro, Minn., for 1910.

[Kreston E. Hoium, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.80	2.90	3.60	2.20	2.28	2.10	2.08	2.29	2.26	2.18
2	.....	2.80	2.80	3.60	2.20	2.25	2.10	2.10	2.26	2.24	2.18
3	.....	2.80	2.80	3.60	2.30	2.25	2.12	2.10	2.21	2.20	2.19
4	.....	2.70	2.90	3.50	2.30	2.28	2.11	2.12	2.21	2.16	2.19
5	.....	2.70	2.90	3.40	2.20	2.25	2.11	2.12	3.75	2.14	2.18
6	.....	2.70	3.70	3.30	2.25	2.22	2.11	2.12	2.90	2.12	2.19
7	.....	2.70	4.40	3.30	2.30	2.22	2.12	2.15	2.55	2.11	2.16
8	.....	2.80	4.80	3.20	2.20	2.21	2.10	2.18	2.48	2.10	2.16
9	.....	2.60	4.80	3.10	2.30	2.24	2.10	2.21	2.38	2.10	2.19
10	.....	2.60	4.70	3.10	2.30	2.25	2.10	2.25	2.24	2.09	2.19
11	.....	2.60	4.70	3.10	2.30	2.22	2.10	2.25	2.21	2.09	2.18
12	.....	2.60	3.80	3.20	2.20	2.21	2.12	2.20	2.20	2.06	2.16
13	.....	2.60	4.70	3.20	2.20	2.20	2.11	2.20	2.21	2.06	2.21
14	.....	2.70	4.70	3.20	2.25	2.18	2.10	2.30	2.24	2.08	2.21
15	.....	2.70	4.60	3.20	2.20	2.16	2.10	2.24	2.25	2.09	2.21
16	.....	2.60	4.40	3.20	2.30	2.15	2.11	2.26	2.24	2.08	2.19
17	.....	2.60	3.80	3.10	2.40	2.12	2.12	2.29	2.24	2.08	2.19
18	.....	2.60	3.80	3.10	2.40	2.12	2.11	2.30	2.21	2.12	2.20
19	.....	2.60	3.70	3.10	2.40	2.10	2.10	2.32	2.21	2.12	2.21
20	.....	2.70	3.60	3.00	2.40	2.12	2.12	2.30	2.24	2.12	2.22
21	.....	2.70	3.60	3.00	2.40	2.11	2.12	2.28	2.25	2.12	2.24
22	.....	2.60	3.60	3.00	2.50	2.15	2.12	2.28	2.26	2.15	2.28
23	.....	2.60	2.80	3.10	2.50	2.15	2.12	2.30	2.24	2.16	2.28
24	.....	2.60	2.80	3.00	2.42	2.15	2.10	2.26	2.22	2.16	2.22
25	.....	2.60	2.70	2.80	2.45	2.15	2.10	2.25	2.24	2.18	2.22
26	.....	2.70	2.70	2.80	2.40	2.15	2.10	2.22	2.25	2.18	2.20
27	.....	2.90	2.80	2.70	2.38	2.15	2.08	2.20	2.26	2.15	2.20
28	.....	2.90	2.80	2.70	2.35	2.14	2.06	2.20	2.28	2.15	2.18
29	.....	.....	2.90	2.60	2.34	2.11	2.05	2.28	2.26	2.18	2.18
30	2.80	.....	2.90	2.50	2.30	2.10	2.05	2.30	2.26	2.15	2.18
31	2.70	.....	2.80	.....	2.29	.....	2.05	2.30	.....	2.18	.....

NOTE.—Ice present from Jan. 1 to Mar. 8, and from Dec. 1 to 31.

WISCONSIN RIVER.

GENERAL FEATURES OF AREA DRAINED.

The drainage basin of Wisconsin River, except for a few square miles, lies wholly within the State of Wisconsin. The river rises in Lake Vieux Desert, lying directly on the boundary line between upper Michigan and Wisconsin, whence it flows in a southwesterly direction for about 300 miles to the city of Portage, near the center of Portage County. At this point it turns westward and empties into Mississippi River at Prairie du Chien, Wis., about 40 miles from the southern boundary of the State. The important tributaries beginning at the sources are as follows: On the west or right

bank of the river, Tomahawk, Rib, Big Eau Pleine, Eau Pleine, Yellow, Lemonweir, Baraboo, Pine, and Kickapoo rivers; on the left bank, Pelican, Prairie, Eau Claire, and Plover rivers.

The total length of the river is about 429 miles. Its basin is about 225 miles long and about 50 miles average width, and comprises approximately 12,280 square miles.

The river flows, for the most part, in the eastern half of its basin. Below Portage it flows within 10 miles of its southern edge. At Portage the divide between Wisconsin River and Fox River is so low that during high water the current in one of the tributaries of the Wisconsin is reversed and flows into the Fox.

Like all the large rivers of the State, the Wisconsin heads in the high drift-covered region. That part of the basin which lies above Nekoosa, including more than half of the drainage area, is underlain by crystalline rocks, which, by presenting a barrier to erosion, cause numerous rapids that afford excellent sites for water power. Below Nekoosa the crystalline rocks give way to the softer sandstone, the disintegration of which has made the bed of the river a succession of shifting sand bars almost without interruption to its mouth. Where this formation is near the surface in the surrounding country the soil is very light and in places even sterile. North of Nekoosa this sandy belt rapidly narrows, and at Merrill, Wis., about 90 miles above, almost entirely disappears, and is replaced by the clayey loams and loamy clays. North of Tomahawk the clays are again replaced by sandy soils containing gravel and by bowlders and glacial drift.

In general the country is level or undulating. In places decided ridges break the surface, as, for example, the Baraboo ranges of quartzite and the bluffs along the lower river. The northern part of the drainage area is covered with innumerable lakes and swamps which tend to make the flow of the stream uniform and steady.

According to the United States Engineer Corps the elevation of Lake Vieux Desert, the source of the river, is about 1,650 feet above sea level; the elevation at the mouth is about 604 feet; the total fall is therefore about 1,050 feet. About 634 feet of this fall occur in the 150 miles between Rhinelander and Nekoosa, an average of over 4 feet to the mile. This descent is concentrated at many places, producing a large number of valuable water-power sites, many of which are still undeveloped.

The dense growth of pine which covered the upper part of the drainage basin of Wisconsin River has nearly all been cut off, and a thick growth of brush and second-growth timber has taken its place. Large areas have been brought under cultivation. In some places this second growth has been burned over, leaving almost impenetrable thickets of brush and dead timber. The effect of this new

growth of brush and timber on the run-off is probably about the same as that of the pine forests which it has replaced.

The mean annual rainfall on the headwaters of the river is about 31 inches; at the lower part of the basin the rainfall is about 34 inches.

The winters, except in the very lowest part of the basin, are severe. The snowfall is comparatively heavy and stays on the ground for long periods, and the streams are covered with ice from 1 to 2 feet in thickness for three or four months. These conditions tend to make the winter season the period of minimum flow, and winter discharge measurements are therefore very valuable.

The basin affords many sites for storage. The United States Engineer Corps located and surveyed eight reservoir sites at the headwaters of Wisconsin River to aid navigation of Mississippi River. The capacity of these reservoirs is about 20,000,000,000 cubic feet, and it was estimated that a flow of 3,000 cubic feet per second could be maintained for three months. Such a flow would nearly double the low-water flow of the river and its resulting water power. Several of these reservoirs have been constructed by private parties for water-power development. The Wisconsin Valley Improvement Co. has been authorized by law to construct, acquire, and maintain a system of reservoirs located on the tributaries of the Wisconsin River north of the south line of township 34, about 6 miles below Tomahawk, for the purpose of producing a uniform flow of water, etc. The law provides that when this company shall have completed reservoirs of a capacity of 2,000,000,000 cubic feet it may collect and receive reasonable tolls from the owner of every improved and operated water power located on the river below such reservoirs. The tolls are to yield not to exceed 6 per cent on the actual investment.

The stream is used quite extensively for logging, but the greater part of the large timber has been cut off and lumbering is decreasing, although considerable pulp wood is being run on the river. Dams at the water-power sites would not interfere seriously with the small run of logs at the present time.

In order to determine the amount of power available along Wisconsin River a survey was made during 1906 between Sauk City and Dekorra and between Lewiston station and Jersey City. From the data collected sheets have been prepared, showing a profile of the water surface, a plan of the river, contour along the bank, and prominent natural or artificial features. The results of this survey have been published on separate sheets and may be obtained by applying to E. A. Birge, director, Wisconsin Geological and Natural History Survey, Madison, Wis. From this survey the following table of distances and elevations has been compiled.

Elevations and distances along Wisconsin River.

Place.	Distance above Sugar Bone Rock.	Elevation above sea level.
	Miles.	*Feet.*
Kilbourn City	3	818
The Narrows	5	819
Lemonweir River	13.5	837
Yellow River	25	858
Little Roche a Cri River	30.5	865
Town line 18–19 N	39	879
Range line 4–5 E	50	896
Section line 20–21	59	905
Foot of rapids below Nekoosa dam	71.3	916
Crest of Nekoosa dam	71.5	939
Foot of dam at Port Edwards	76.5	948
Crest of dam at Port Edwards	76.5	958
Tail-water dam below Grand Rapids	78	960
Headwater dam below Grand Rapids	78	971
Tailwater Grand Rapids dam	80.5	978
Headwater Grand Rapids dam	80.5	1,004
Tail-water dam above Grand Rapids	83	1,006
Headwater dam above Grand Rapids	.....	1,018
Foot of lower dam at Conant Rapids	97	1,035
Crest of lower dam at Conant Rapids	97	1,044
Foot of upper dam at Conant Rapids	97.5	1,044
Crest of upper dam at Conant Rapids	.....	1,061
Foot of rapids below Stevens Point dam	100	1,066
Crest of dam	100	1,077
Knowlton	120	1,095
Foot of Mosinee dam	130	1,111
Crest of Mosinee dam	130	1,126
Crest, Little Bull Falls	130.5	1,129
Eau Claire River	142.5	1,142
Foot of Wausau dam	147	1,158
Crest of Wausau dam	147	1,179
Foot of Brokaw dam	152	1,186
Crest of Brokaw dam	152	1,201
Marathon–Lincoln County line	160.5	1,214
Foot of lower dam at Merrill	167	1,233
Crest of lower dam at Merrill	167	1,245
Foot of upper dam at Merrill	169	1,246
Crest of upper dam at Merrill	169	1,251
Range line 5–6 E	178	1,280
Foot of Grandfather Falls	181	1,300
Crest of Grandfather Falls	182.5	1,385
Foot of Tomahawk dam	194.5	1,417
Crest of Tomahawk dam	194.5	1,431

A survey was also made along Eau Claire River during 1906, from the mouth of the river to Johnson. From the data collected sheets have been prepared, showing a profile of the water surface, a plan of the river, contours along the bank, and prominent natural or artificial features. The results of this survey have been published on separate sheets and may be obtained by applying to E. A. Birge, director Wisconsin Geological and Natural History Survey, Madison, Wis.

WISCONSIN RIVER NEAR RHINELANDER, WIS.[1]

This station, which is located at a highway bridge about 8 miles southwest of Rhinelander, Wis., in sec. 27, T. 36 N., R. 8 E., at Forbes & Wixson's power station, was established December 1, 1905, to obtain data for studies of water power, water supply, pollution, and storage problems.

[1] Information in regard to this station prior to 1908 is contained also in Bulletin 20 of the Wisconsin Geological and Natural History Survey, entitled "Water powers of Wisconsin," by Leonard S. Smith.

Pelican River enters about 8 miles above the station.

The winters in this vicinity are severe, but the operation of the power plant about 400 feet above the bridge prevents the river from freezing at the gaging section, and ice forms only in narrow strips along the shores. The pond above the dam modifies the normal flow, and the total range in gage height is small. The fluctuations of the load on the turbines may also affect discharge measurements.

The station was last visited in July, 1908. As far as known the datum of the gage has remained constant and the records are reliable and accurate.

The gage reader at the station is paid by the Wisconsin Valley Improvement Co., Wausau, Wis.

Daily gage height, in feet, of Wisconsin River near Rhinelander, Wis., for 1910.

[Geo. N. Kramer, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.8	2.8	2.9	3.1	2.6	2.4	2.2	2.3	2.0	2.2	2.3	2.1
2	2.8	2.8	3.0	3.3	3.1	2.2	2.2	2.2	2.7	1.7	2.4	2.1
3	3.1	3.1	3.5	2.0	2.9	2.4	1.1	2.1	2.4	2.1	2.2	1.6
4	2.5	3.1	2.9	2.8	3.0	2.4	1.0	2.1	1.2	2.0	2.2	1.6
5	3.2	3.2	3.5	3.3	3.0	1.7	2.2	2.1	1.8	2.0	2.1	1.9
6	3.0	2.2	2.1	3.4	3.1	2.7	2.2	2.1	2.4	2.8	1.7	2.2
7	2.5	3.2	3.0	3.3	2.9	2.3	2.9	1.2	2.2	2.2	2.3	2.5
8	3.3	2.7	2.7	3.3	1.9	2.8	2.3	2.1	2.4	2.3	2.3	2.3
9	2.8	2.6	2.4	3.0	2.9	2.5	2.2	2.1	2.4	1.6	2.2	2.2
10	2.8	3.1	2.3	2.0	2.2	2.3	1.1	2.4	2.4	2.2	2.3	2.2
11	3.0	2.8	2.5	2.9	2.6	2.3	2.3	2.2	1.7	2.2	2.3	2.2
12	3.0	3.1	2.8	3.0	2.2	1.0	2.3	2.1	2.4	2.2	2.3	2.2
13	3.1	2.8	2.0	2.8	2.2	2.4	2.2	2.3	2.4	2.1	1.8	2.2
14	3.0	2.7	2.8	2.5	2.2	2.5	2.2	2.0	2.5	1.9	2.2	2.2
15	3.1	2.9	2.5	2.8	1.6	2.2	2.3	2.2	2.6	1.9	2.3	2.3
16	2.8	3.4	2.8	2.9	2.4	2.2	2.4	2.3	2.5	1.6	2.3	2.5
17	2.7	2.7	2.7	2.2	2.6	2.2	1.0	2.2	2.5	2.1	2.3	2.4
18	3.1	3.2	2.8	3.0	2.2	2.2	2.3	2.2	1.1	2.1	2.2	2.2
19	2.8	3.3	2.7	3.0	2.6	1.0	2.3	2.0	2.3	2.1	2.2	2.2
20	3.0	2.1	1.8	2.6	2.8	2.2	2.1	1.9	2.4	2.2	1.6	2.3
21	3.0	3.4	2.7	3.0	2.9	2.2	2.3	1.1	2.2	2.2	2.1	2.2
22	2.8	3.3	2.9	2.8	2.3	2.2	2.3	2.0	2.0	2.2	2.1	2.2
23	2.9	2.9	3.0	2.7	3.0	2.1	2.0	2.0	2.0	1.7	2.1	2.2
24	2.7	3.3	3.2	2.1	2.9	2.2	1.7	2.1	2.0	2.1	2.2	1.9
25	2.6	3.4	3.2	2.6	3.0	2.2	2.0	2.1	1.1	2.1	2.2	1.9
26	2.8	3.4	3.2	3.0	3.1	1.0	2.0	2.2	2.1	2.1	2.1	2.2
27	2.6	2.8	2.2	3.0	3.0	2.1	2.4	2.2	2.1	2.6	1.8	2.6
28	2.5	3.4	3.4	3.1	2.9	2.1	2.1	1.7	2.2	2.4	2.4	2.7
29	2.5	.....	3.2	3.3	2.1	2.1	2.3	2.0	2.2	2.6	2.2	2.5
30	2.8	.....	2.9	3.2	2.9	2.2	2.1	2.0	2.2	1.8	2.2	2.3
31	2.8	.....	3.0	.....	2.8	.....	1.7	2.0	.....	2.3	.....	2.6

WISCONSIN RIVER AT MERRILL, WIS.[1]

This station, which is located at a highway bridge at the east end of Merrill, Wis., was established November 17, 1902, to obtain data for water power, water supply, pollution, and storage problems.

[1] Information in regard to this station is contained also in Bulletin 20 of the Wisconsin Geological and Natural History Survey, entitled "Water powers of Wisconsin," by Leonard S. Smith.

The bridge is about 1,000 feet below a dam. Prairie River enters from the east about half a mile above the station. The flow is somewhat modified by the dam and power plants above the station.

The current is so swift that ice does not form across the section, and there is open water at the gage the year around, but winters are severe, and the relation between gage height and discharge is affected by backwater caused by ice. The stream is used considerably for log running, and backwater caused by jams below the measuring section may affect the gage heights for short periods.

The datum of the chain gage has remained unchanged; the records are reliable and accurate except as conditions above may affect the readings.

This station was last visited in February, 1909.

The gage reader at this station has been paid by the Wisconsin Valley Improvement Co., Wausau, Wis., since April, 1909.

Daily gage height, in feet, of Wisconsin River at Merrill, Wis., for 1910.

[A. F. Lueck, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.75	4.9	4.8	5.7	5.95	5.25	4.0	3.35	4.35	4.4	3.95	3.85
2	4.65	4.9	5.0	5.8	5.7	4.7	3.95	3.35	4.35	4.3	4.2	3.95
3	4.9	4.9	4.85	5.75	5.65	4.65	3.5	4.3	4.35	4.1	4.6	3.95
4	4.95	5.05	4.95	5.2	5.3	4.5	3.15	4.1	4.25	4.55	4.55	3.85
5	4.8	5.05	5.0	5.0	4.85	4.05	2.95	4.15	4.35	4.2	4.75	3.6
6	4.95	4.85	5.2	6.45	4.8	3.35	3.35	3.95	4.15	4.4	3.9	3.75
7	4.95	4.75	5.3	7.1	4.65	4.65	2.7	3.95	3.95	4.55	3.9	3.9
8	4.95	4.3	4.95	6.9	4.8	4.45	3.35	3.6	4.0	4.65	3.85	3.9
9	4.9	4.9	4.85	6.5	4.95	4.75	4.2	3.85	4.2	4.3	4.35	3.8
10	4.95	4.9	4.55	6.1	4.9	4.8	4.15	3.95	4.5	4.35	3.95	3.95
11	5.05	4.75	4.75	5.85	4.8	4.55	4.1	2.9	4.4	4.3	3.55	4.05
12	4.9	4.9	4.75	5.5	4.65	4.35	3.4	4.0	4.3	4.15	4.35	3.95
13	4.8	4.8	4.75	5.9	4.7	4.5	3.95	2.75	4.1	4.2	4.15	4.05
14	4.85	4.65	4.9	5.75	4.35	4.4	4.1	3.9	4.55	3.7	4.5	4.15
15	4.85	4.7	5.4	5.25	4.2	4.15	4.0	3.4	5.0	4.35	4.2	4.15
16	4.95	4.95	5.25	5.45	4.25	4.05	4.15	3.7	4.6	3.2	4.15	4.05
17	4.8	4.75	5.2	5.7	4.15	3.55	3.95	3.95	3.95	3.95	4.2	4.45
18	4.95	4.75	5.0	6.0	5.35	4.15	3.85	3.95	4.15	4.25	4.2	4.05
19	4.9	4.9	5.2	6.2	5.65	4.15	3.8	4.0	3.65	4.3	4.15	4.2
20	4.95	4.8	5.3	6.15	6.15	3.4	3.95	3.95	4.25	4.5	4.05	4.2
21	4.8	4.65	6.1	6.35	6.1	3.65	3.4	3.85	4.05	4.2	4.05	4.35
22	4.85	4.95	6.2	6.3	6.15	3.9	4.0	3.3	4.1	4.55	3.95	4.4
23	4.8	4.9	6.1	6.0	6.25	3.45	4.05	4.0	3.85	4.65	3.8	4.5
24	4.9	5.05	5.85	6.1	6.05	3.5	3.8	3.85	3.7	4.7	3.9	4.6
25	4.5	4.85	5.8	5.65	5.65	4.0	4.05	4.1	3.95	4.5	3.85	4.65
26	4.75	5.05	6.05	6.05	5.5	3.0	4.05	4.1	4.1	4.1	3.95	4.35
27	4.9	4.9	5.95	6.4	5.55	2.8	4.0	4.25	4.3	4.55	3.95	3.6
28	5.05	4.7	5.7	6.4	5.9	4.05	4.05	4.0	4.2	4.7	4.0	4.25
29	4.65	.....	5.75	6.3	5.2	4.05	4.05	3.9	3.65	4.45	4.2	4.3
30	4.65	.....	6.0	6.1	4.6	4.05	4.0	4.0	4.4	4.35	3.95	4.4
31	4.8	.....	6.35	.....	4.95	.....	4.05	4.4	.....	4.5	.....	4.65

WISCONSIN RIVER NEAR NECEDAH, WIS.[1]

This station, which is located at the highway bridge about 3 miles east of Necedah, Wis., on the road from Necedah to Strongs Prairie, was established December 2, 1902, to obtain data for studying water power, water supply, and pollution problems.

Big Roche a Cri Creek enters from the west about 5 miles below the station. The drainage area above the section is about 5,800 square miles.

The winters in this region are severe. Ice forms from 1 to 2 feet in thickness and lasts for about three months. Part of the river bottom is liable to shift in floods. But few discharge measurements have been made since 1906. The 1906 discharge table should not be used for later years.

The datum of the chain gage has remained unchanged. The gage heights are reliable and accurate.

The gage reader at this station has been paid since April, 1909, by the Wisconsin Valley Improvement Co., Wausau, Wis.

Discharge measurements of Wisconsin River near Necedah, Wis., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 20	Stewart and Babcock[a]	210	348	2.10	543
22	do.[a]	282	667	3.80	850
Sept. 9	V. H. Reineking[b]	270	839	4.75	1,800

[a] Meter was held at mid-depth for velocity reading and a coefficient of 0.92 applied to the result to reduce it to the mean velocity of each section. Measurement made by engineers of the Wisconsin Valley Improvement Co.

[b] Mean velocity obtained in each section by the vertical curve method. Measurement made by engineer employed by D. W. Mead.

Daily gage height, in feet, of Wisconsin River near Necedah, Wis., for 1910.

[M. Coughlin, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	6.9	8.4	6.0	4.85	4.2	4.5	4.4	4.9	6.0
2	.....	.....	.....	7.0	7.95	5.95	4.5	4.75	4.75	4.5	4.9	6.5
3	.....	.....	.....	7.0	7.55	5.8	4.75	4.4	4.7	4.2	5.15	.....
4	.....	6.55	.....	6.8	7.25	5.7	4.5	4.15	4.85	5.2	5.2	.....
5	.....	.....	6.65	6.8	6.65	5.6	4.1	4.25	5.15	4.6	5.3	.....
6	.....	.....	.....	6.45	6.55	5.4	5.0	4.2	5.25	4.75	5.25	.....
7	6.8	.....	.....	6.8	6.6	5.7	5.4	4.45	4.6	4.9	4.7	.....
8	.....	.....	.....	8.1	6.45	5.15	4.4	4.1	4.55	4.7	4.65	.....
9	.....	.....	.....	9.1	6.0	5.4	4.4	4.75	4.85	4.35	4.6	.....
10	.....	.....	.....	8.85	6.2	5.45	4.35	4.25	4.8	5.3	4.9	.....
11	.....	6.55	6.8	8.4	6 0	5.3	4.3	4.4	4.35	5.4	5.2	.....
12	.....	.....	.....	7.95	5.8	5.3	4.45	4.25	4.75	4.85	5.25	5.75
13	.....	.....	.....	7.35	5.65	5.15	4.45	4.4	4.9	5.0	4.95	.....
14	6.8	.....	.....	7.1	5.5	5.3	4.4	4.55	4.4	4.8	4.9	.....
15	.....	.....	7.0	6.75	5.65	5.1	4.45	4.1	5.0	4.65	5.25	.....

[1] Information in regard to this station prior to 1908 is contained also in Bulletin 20 of the Wisconsin Geological and Natural History Survey, entitled "Water powers of Wisconsin," by Leonard S Smith

Daily gage height, in feet, of Wisconsin River, near Necedah, Wis., for 1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	.....	.....	6.8	6.7	5.35	4.9	4.55	4.5	5.3	4.7	4.75	.....
17	.....	.....	7.25	6.9	5.7	4.9	4.35	4.4	4.85	4.4	4.65	.....
18	.....	6.55	6.55	6.6	5.3	4.7	4.7	4.2	4.7	5.0	4.65	.....
19	.....	.....	6.3	6.95	5.65	4.95	4.3	4.4	4.9	4.6	4.6	5.5
20	.....	.....	6.45	7.75	5.45	4.9	4.2	4.65	5.1	5.0	4.7	.....
21	6.75	.....	6.25	7.85	6.35	5.1	4.5	4.75	4.5	5.1	4.7	.....
22	.....	.....	7.95	7.8	6.85	4.85	4.3	4.25	5.1	5.1	5.35	.....
23	.....	.....	7.55	7.75	6.65	4.8	4.6	4.55	4.95	4.6	5.15	.....
24	.....	.....	7.65	7.55	6.9	4.8	4.6	4.45	4.85	5.5	4.6	.....
25	.....	6.5	7.8	7.7	7.1	4.7	4.1	4.25	4.9	4.6	4.55	.....
26	.....	.....	7.65	8.0	7.1	4.75	4.65	4.45	5.7	4.55	4.6	5.1
27	.....	.....	7.85	8.0	6.8	4.8	4.55	4.4	4.65	4.45	4.95	.....
28	6.8	.....	7.65	8.2	6.75	4.9	4.35	4.3	4.6	4.6	4.55	.....
29	.....	.....	7.7	9.0	6.6	4.75	4.2	4.2	4.45	4.3	5.25	.....
30	.....	.....	7.25	8.85	6.45	4.5	4.35	4.7	4.75	4.35	4.9	.....
31	.....	.....	7.0	.....	6.3	.....	4.5	4.4	.....	4.15	.....	.....

NOTE.—Ice present from Jan. 1 to Mar. 14, ranging in thickness from 1.2 to 1.6 feet. Ice existed also from Dec. 3 to 31, its average thickness being approximately 1 foot.

WAPSIPINICON RIVER.

GENERAL FEATURES OF AREA DRAINED.

The drainage basin of Wapsipinicon River lies almost entirely in the northwestern part of Iowa. The river rises a few miles north of the Minnesota State line in Mower County, flows southeastward, and joins the Mississippi along the southern boundary of Clinton County, Iowa, about 10 miles below the city of Clinton, Iowa. The length of the river, not following the numerous bends, is about 220 miles, and the total length by stream course is not far from 300 miles. The drainage basin is approximately 185 miles long and 14 miles in average width.

The tributaries are all small. The more important are the West, Middle, and East branches, which unite above Tripoli in Bremer County, and Little Wapsipinicon River and Buffalo Creek, which enter from the east.

The basin is underlain by limestones which have been thinly covered with glacial drift. The surface of the country is a gently undulating prairie, and the valley of the river is narrow with gently sloping sides. Near Anamosa the valley is narrow and picturesque; the bed and banks are rocky, the banks rising to a good height and in places running abruptly up into bluffs.

The elevation of the sources of the river is about 1,250 feet; at Independence the elevation is about 900 feet; at Stone City, about 780 feet; at the mouth the elevation is 560 feet.

The drainage basin contains no forested areas. The mean annual rainfall is about 32 inches. The winters are severe, snowfall is heavy, and ice forms from 1 to 2 feet in thickness and lasts about three months.

Storage sites have not been investigated, but the toporagphy of the basin is unfavorable and the high value of the land for farming would undoubtedly prohibit the construction of reservoirs.

A number of fair power sites are found along the river, some of which have been developed. Conditions are favorable for building dams, as the banks are as a rule firm, and rock forms the river bed in many places. The geological formation tends to keep the flow of the river fairly uniform and steady, as the glacial drift is thin and much of the rainfall reaches the river through springs.

WAPSIPINICON RIVER AT STONE CITY, IOWA.

This station is located at Stone City, Iowa, at the highway bridge, a short distance above the Chicago, Milwaukee & St. Paul Railway bridge. It was established August 19, 1903, to obtain data for use in studying water power, water supply, and pollution problems.

Buffalo Creek is tributary about 4 miles below the station.

Discharge measurements are made from the highway bridge to which the gage is attached.

Winters are severe; ice forms from 1 to 2 feet in thickness and lasts about three months.

The gage readings at this station are furnished by the courtesy of Mr. Frank Dearborn.

Daily gage height, in feet, of Wapsipinicon River at Stone City, Iowa, for 1910.

[Frank Dearborn, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	4.22	3.50	3.42	2.70	2.30	2.50	2.85	2.52	2.15
2	.....	2.95	3.55	4.05	3.30	3.40	2.70	2.30	2.44	2.80	2.50	.....
3	.....	.....	.....	3.95	3.40	3.25	2.68	2.30	2.40	2.84	2.48	.....
4	.....	.....	.....	3.80	3.38	3.22	2.65	2.28	2.40	2.80	2.45	.....
5	3.96	.....	.....	3.82	3.33	3.18	2.62	2.28	2.48	2.73	2.45	.....
6	.....	.....	4.15	4.45	3.28	3.15	2.62	2.28	2.54	2.73	2.45	.....
7	.....	.....	6.05	4.52	3.20	3.10	2.58	2.25	2.50	2.70	2.42	2.32
8	.....	.....	6.45	4.23	3.18	3.07	2.53	2.25	2.50	2.70	2.42	.....
9	.....	3.35	7.05	4.00	3.15	3.08	2.52	2.24	2.54	2.65	2.40	.....
10	.....	.....	7.70	3.85	3.15	3.05	2.50	2.22	2.58	2.65	2.40	.....
11	.....	.....	8.00	3.70	3.13	3.02	2.50	2.22	2.55	2.62	2.40	.....
12	.....	.....	9.05	3.62	3.10	3.00	2.50	2.20	2.50	2.62	2.40	.....
13	3.73	.....	8.86	3.60	3.08	3.08	2.45	2.18	2.50	2.60	2.40	.....
14	.....	.....	9.30	3.65	3.06	2.95	2.45	2.17	2.58	2.62	2.42	2.25
15	.....	3.97	8.85	3.78	3.05	2.92	2.44	2.15	2.52	2.60	2.42	.....
16	.....	.....	10.97	3.80	3.05	2.90	2.42	2.25	2.55	2.60	2.40	.....
17	.....	.....	11.30	3.88	3.25	2.86	2.40	2.22	2.60	2.58	2.45	.....
18	.....	.....	11.00	3.80	3.58	2.85	2.40	2.65	2.58	2.60	2.40	.....
19	.....	.....	10.20	3.66	3.48	2.82	2.40	2.30	2.54	2.55	2.40	.....
20	3.69	.....	8.92	3.59	3.36	2.80	2.40	2.25	2.50	2.58	2.40	.....
21	.....	.....	8.08	3.55	3.32	2.80	2.40	3.65	2.55	2.60	2.38	2.28
22	.....	.....	7.35	3.50	3.52	2.78	2.40	2.95	2.50	2.55	2.38	.....
23	.....	3.70	6.90	3.53	3.80	2.75	2.40	2.73	2.65	2.52	2.35	.....
24	3.00	.....	6.55	3.62	3.63	2.72	2.38	2.65	2.84	2.55	2.40	.....
25	.....	.....	6.18	3.55	3.70	2.69	2.35	2.62	2.68	2.60	2.42	.....
26	.....	.....	5.92	3.50	3.62	2.68	2.34	2.52	2.95	2.60	2.45	.....
27	.....	.....	5.55	3.48	3.50	2.82	2.34	2.50	3.22	2.60	2.55	.....
28	.....	.....	5.30	3.42	3.42	2.75	2.42	2.50	2.95	2.55	2.70	2.25
29	.....	.....	4.95	3.40	3.55	2.68	2.38	2.50	2.94	2.55	2.05	.....
30	.....	.....	4.57	3.37	3.65	2.70	2.33	2.50	2.90	2.55	2.10	.....
31	.....	.....	4.32	.....	3.58	.....	2.31	2.50	.....	2.56	.....	.....

NOTE.—Ice present from Jan. 1 to Mar. 5, ranging in thickness from 10 inches to 13 inches. Ice also covered the river from Dec. 1 to 31, its thickness being about 9 inches.

Daily discharge, in second-feet, of Wapsipinicon River at Stone City, Iowa, for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	510	830	470	430	162	78	115	204	119	.....
2	.....	.....	495	745	370	420	162	78	103	189	115	.....
3	.....	.....	510	695	420	348	157	78	95	201	111	.....
4	.....	.....	540	620	410	335	150	75	95	189	105	.....
5	.....	.....	580	630	385	318	142	75	111	170	105	.....
6	.....	.....	795	945	361	306	142	75	124	170	105	.....
7	.....	.....	1,850	980	326	286	133	70	115	162	99	.....
8	.....	.....	2,090	835	318	275	122	70	115	162	99	.....
9	.....	.....	2,480	720	306	279	119	69	124	150	95	.....
10	.....	.....	2,910	645	306	268	115	66	133	150	95	.....
11	.....	.....	3,120	570	298	257	115	66	126	142	95	.....
12	.....	.....	3,890	530	286	250	115	63	115	142	95	.....
13	.....	.....	3,740	520	279	279	105	60	115	137	95	.....
14	.....	.....	4,080	545	272	234	105	59	133	142	99	.....
15	.....	.....	3,740	610	268	224	103	56	119	137	99	.....
16	.....	.....	5,490	620	268	218	99	70	126	137	95	.....
17	.....	.....	5,830	660	348	206	95	66	137	133	105	.....
18	.....	.....	5,520	620	510	204	95	150	133	137	95	.....
19	.....	.....	4,820	550	460	195	95	78	124	126	95	.....
20	.....	.....	3,790	515	400	189	95	70	115	133	95	.....
21	.....	.....	3,180	495	380	189	95	545	126	137	92	.....
22	.....	.....	2,680	470	480	184	95	234	115	126	92	.....
23	.....	.....	2,380	485	620	176	95	170	150	119	86	.....
24	.....	.....	2,160	530	535	167	92	150	201	126	95	.....
25	.....	.....	1,930	495	570	160	86	142	157	137	99	.....
26	.....	.....	1,770	470	530	157	85	119	234	137	105	.....
27	.....	.....	1,550	460	470	195	85	115	335	137	126	.....
28	.....	.....	1,400	430	430	176	99	115	234	126	162	.....
29	.....	.....	1,210	420	495	157	92	115	231	126	45	.....
30	.....	.....	1,000	405	545	162	83	115	218	126	50	.....
31	.....	.....	880	.....	510	.....	80	115	.....	128	.....	.....

NOTE.—Daily discharge computed from a well-defined rating curve based on measurements made from 1904 to 1906, and checked by measurement made in 1911. From Mar. 1 to 5 the discharge was estimated because of the presence of ice.

Monthly discharge of Wapsipinicon River at Stone City, Iowa, for 1910.

[Drainage area, 1,310 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
March	5,830	495	2,480	1.91	2.20	B.
April	980	405	602	.460	.51	B.
May	620	268	407	.311	.36	B.
June	430	157	241	.184	.21	B.
July	162	80	110	.084	.10	B.
August	545	56	110	.084	.10	B.
September	335	95	146	.111	.12	B.
October	204	119	142	.108	.12	B.
November	162	45	98.9	.075	.08	B.

IOWA RIVER.

GENERAL FEATURES OF AREA DRAINED.

The drainage basin of Iowa River and its tributary, Cedar River, occupies the north-central and southeast-central part of the State of Iowa, and parts of Freeborn, Dodge, Steele, and Mower counties in southern Minnesota. The river rises in the northern part of Hancock

County, Iowa, flows southeastward, and joins Mississippi River in the southeastern part of Louisa County. The length of Iowa River is about 270 miles, not following the bends. The total drainage area is about 12,400 square miles.

Cedar River, which is called a tributary of the Iowa, although its drainage area above their junction is much the larger, rises in the southern part of Dodge County, in southern Minnesota, flows southeastward into Iowa, and continues in that direction until it reaches Moscow, in the northern part of Muscatine County, where it makes an abrupt turn to the southwest and joins the Iowa in Louisa County. The river is about 260 miles long, not following the bends. In its upper course it is called Red Cedar River. The drainage area above its mouth is about 7,600 square miles. It is the only important tributary of the Iowa. The principal tributaries of Cedar River are Little Cedar, Shell Rock, and West Fork of Red Cedar rivers, all of which are tributary above Waterloo.

The drainage basin of Iowa River proper is long and narrow. The river rises in a broad, flat, or slightly undulating drift region, and the first rock exposed in its valley is the limestone that forms the rocky banks of the stream in the southwestern corner of Franklin County; from this point to its confluence with the Cedar, the river crosses a succession of sedimentary rocks. The drift which covers this region is well supplied with springs which help maintain the flow of the stream. The surface of the surrounding country is a gently undulating prairie.

The area is thinly covered with glacial drift underlain by limestone, which is exposed at many places along the main stream and its tributaries. The valleys of the upper tributaries are narrow, with gently sloping sides; below the mouth of the Shell Rock the valley is broad and shallow and is separated from the uplands by distinctly defined borders. The surface of the country is a gently undulating prairie, apparently level in some sections. The upper basin is about 50 miles wide, but the lower is much narrower, and at one point below Cedar Rapids it measures only 8 or 9 miles across.

At the headwaters of both Iowa and Cedar rivers are a few lakes, ranging in area from 2 to 10 square miles.

The elevation of the sources of Iowa River is about 1,250 feet above sea level; at Iowa City the elevation is 670 feet; at the mouth of the Cedar it is 565 feet, and at the junction with the Mississippi the elevation is about 522 feet. The elevation of the sources of Cedar River is about 1,300 feet; at Waterloo about 820 feet; at Cedar Rapids about 725 feet, and at the mouth about 565 feet.

The basin contains no large forested areas. The mean annual rainfall is about 32 inches. The winters are severe, especially in the

upper part of the basin. The fall of snow is comparatively heavy, and ice forms to considerable thickness on the streams and lasts for three to four months.

It may be possible to make storage reservoirs at the lakes at the headwaters of both Cedar and Iowa rivers, but the overflow damages would undoubtedly prohibit their construction.

Iowa and Cedar rivers are by far the most important streams in Iowa for water power. Power sites of small head are numerous, and a number of them have been developed. Those on Cedar River are more important than those on the Iowa. The numerous rock outcrops furnish good foundations for dams. The flow of the streams is sustained by numerous springs, but during long-continued droughts the flow becomes very low.

CEDAR RIVER NEAR AUSTIN, MINN.

This station, which is located just below the Red Cedar mill dam, 2 miles below Austin, in sec. 15, T. 102 N., R. 18 W., was established May 29, 1909, for the purpose of determining the amount of water power available on Cedar River.

The nearest tributary, Turtle Creek, enters the Cedar 1 mile above the station.

Immediately above the station is the power plant known as Red Cedar Mill. During the low-water season the water is drawn down below the crest of the dam by the end of the 10 or 12 hour run, and after the turbine is closed the water is held back for several hours before it has risen sufficiently to flow over the crest. Consequently the stage of the river changes considerably during each 24 hours. In order to get a mean gage height the gage is read five times daily, as follows: Before the turbine is started in the morning, one hour after starting, at noon, just before shutting down the turbine at night, and half an hour later.

Observations are little affected by ice during the winter months, as the gage is placed near the tailrace of the mill where the river remains open for the most part. A measurement made during February, 1910, gave a result 20 per cent smaller than was indicated by the open channel curve, but it is probable that this discrepancy was largely due to the freezing of the meter, owing to the manner of making the measurement. The winter flow has been computed by reducing the open-season rating 10 per cent.

Since the establishment of the station the datum of the staff gage has remained unchanged.

The natural conditions of flow at this point are excellent, and as there is a favorable measuring section at the highway bridge 100 yards below the gage, excellent results would be obtained were it not

for the uncertainty in mean daily gage height resulting from the controlled flow. The system of five daily readings should, however, give the mean with a good degree of accuracy.

Discharge measurements of Cedar River near Austin, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 29	J. C. Hoyt	107	136	4.48	128
June 18	G. A. Gray	111	172	4.85	218
18	C. B. Gibson	111	147	4.85	231
July 14	G. A. Gray	108	94.5	3.90	48.6
Aug. 24	Robert Follansbee	113	164	4.67	189
1910.					
Feb. 9	G. A. Gray	99	102	4.62	[a]130
Mar. 12	C. J. Emerson	125	475	6.92	1,110
Apr. 28	G. A. Gray	110	113	4.27	85.6
July 18	.....do	108	100	4.00	49.6

[a] Probably affected by meter freezing.

Daily gage height, in feet, of Cedar River near Austin, Minn., for 1910.

[James C. King, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.73	4.38	4.25	4.64	4.10	4.18	4.04	4.06	4.06	3.97	4.10	3.46
2	3.92	4.44	4.30	4.58	4.15	4.11	4.08	3.96	4.06	3.67	4.06	4.30
3	4.57	4.43	4.42	4.44	4.14	4.08	3.65	4.12	4.04	4.08	4.02	4.00
4	4.49	4.30	4.42	4.56	4.16	4.11	3.68	4.00	3.64	4.00	4.00	3.45
5	4.55	4.34	4.74	4.48	4.03	3.53	4.04	3.83	4.02	4.00	4.04	4.03
6	4.57	4.04	5.33	4.47	4.10	3.96	4.05	4.06	4.10	3.99	3.42	3.46
7	4.54	4.42	6.48	4.44	4.10	4.09	4.00	3.46	4.04	4.00	4.01	4.16
8	4.54	4.36	7.37	4.43	4.08	4.08	3.82	4.00	4.07	4.00	4.00	4.06
9	4.38	4.25	7.44	4.32	4.07	3.95	4.00	4.00	4.06	3.48	4.01	3.41
10	4.48	4.30	6.90	4.09	4.20	4.04	3.92	3.52	4.02	4.10	4.04	4.00
11	4.46	4.32	6.93	4.26	4.10	4.16	3.94	4.02	3.60	4.00	4.06	3.45
12	4.43	4.37	7.00	4.26	4.02	3.80	4.08	4.02	4.07	3.80	3.41	4.02
13	4.41	4.13	8.66	4.28	4.08	4.10	4.11	4.02	4.04	4.02	3.43	4.01
14	4.29	4.39	8.09	4.28	4.04	4.06	4.10	3.50	4.00	4.01	4.02	4.01
15	4.41	4.38	7.14	4.28	3.64	4.06	4.18	4.01	3.98	4.00	4.02	3.41
16	4.30	4.36	6.44	4.28	4.15	4.06	3.94	4.06	4.00	3.53	3.61	4.02
17	4.52	4.32	6.02	4.16	4.38	4.06	3.81	4.03	4.00	4.10	4.08	4.00
18	4.38	4.26	5.75	4.38	4.12	4.04	4.02	4.00	3.51	4.04	4.01	3.45
19	4.34	4.31	5.78	4.32	4.20	3.69	3.94	4.01	4.05	4.08	4.01	4.06
20	4.36	4.17	5.83	4.25	4.26	4.00	4.28	4.04	4.02	4.00	3.50	4.08
21	4.36	4.34	5.79	4.28	4.28	4.04	4.06	3.78	4.00	4.04	4.28	3.41
22	4.35	4.23	5.60	4.31	4.27	3.83	4.05	4.01	4.02	4.00	4.25	3.49
23	4.28	4.34	5.37	4.12	4.20	3.85	4.02	4.04	4.02	3.63	3.49	4.08
24	4.34	4.25	5.30	4.11	4.32	3.90	3.73	4.04	4.02	4.08	3.72	4.04
25	4.34	4.10	5.17	4.37	4.21	3.93	4.02	4.03	3.49	3.80	4.32	3.49
26	4.37	4.22	5.09	4.24	3.80	3.93	4.02	4.02	4.01	4.06	4.24	3.67
27	4.33	4.02	4.92	4.17	4.17	3.96	3.98	4.03	4.01	4.00	3.44	4.07
28	4.32	4.26	4.83	4.20	4.12	3.95	3.98	3.75	4.03	3.96	4.01	4.06
29	4.32	.....	4.77	4.22	4.09	4.11	3.59	4.06	4.02	3.98	4.00	3.98
30	4.15	.....	4.75	4.21	4.01	4.06	3.90	4.06	3.99	3.92	3.44	3.43
31	4.39	.....	4.62	.....	4.18	.....	3.67	4.00	.....	4.08	.....	4.08

Daily discharge, in second-feet, of Cedar River near Austin, Minn., for 1909–10.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1						163	181	36	76	70	122	632
2						146	155	73	70	70	502	632
3						146	111	62	76	40	443	849
4						289	84	46	70	48	302	926
5						309	92	47	48	52	209	424
6						309	111	18	76	58	144	352
7						322	96	37	70	63	132	318
8						302	92	15	63	63	76	254
9						362	58	34	70	63	92	132
10						302	111	40	52	63	76	168
11						251	58	49	58	92	239	138
12						184	70	70	48	84	774	117
13						132	38	155	84	122	1,540	138
14						302	75	1,880	144	84	5,230	138
15						459	47	2,830	155	76	3,740	128
16						248	40	1,930	155	76	2,230	117
17						248	43	1,380	122	63	1,320	117
18						195	40	1,070	111	84	900	108
19						144	48	702	48	63	632	98
20						84	58	474	63	92	565	150
21						132	38	335	70	92	678	98
22						84	46	206	63	102	678	117
23						92	43	195	92	102	523	161
24						84	43	144	92	48	523	98
25						144	46	103	84	70	443	68
26						168	43	122	58	111	750	68
27						600	44	102	76	76	2,890	98
28						678	41	100	70	44	2,120	161
29					96	462	40	51	70	48	1,270	161
30					103	309	37	75	70	48	774	108
31					245	.....	43	79	.....	34	.....	108
1910.												
1	169	95	75	165	63	73	56	59	59	49	63	16
2	40	106	82	150	70	64	61	49	59	28	59	82
3	132	104	102	119	68	61	28	66	56	61	54	48
4	115	82	102	146	71	64	30	52	28	52	52	16
5	128	88	192	128	55	23	56	39	54	52	56	50
6	132	52	380	126	63	49	58	59	63	51	19	16
7	125	102	890	119	63	62	52	20	56	52	53	64
8	125	92	1,360	117	61	61	38	52	60	52	52	53
9	95	75	1,400	96	60	48	52	52	59	21	53	14
10	113	82	1,110	62	76	56	46	23	54	63	56	48
11	109	85	1,120	86	63	71	47	54	26	52	59	16
12	104	93	1,160	86	54	37	61	54	60	37	18	50
13	100	60	2,070	89	61	63	64	54	56	54	19	40
14	81	96	1,760	89	56	59	63	22	52	53	54	49
15	100	95	1,240	89	28	59	73	53	50	52	54	14
16	82	92	869	89	70	59	47	59	52	23	26	50
17	121	85	664	71	107	59	38	55	52	63	61	48
18	95	76	544	107	66	56	54	52	22	56	53	16
19	88	84	557	96	76	30	47	53	58	61	53	53
20	92	65	578	84	86	52	89	56	54	52	22	55
21	92	88	561	89	89	56	59	36	52	56	89	14
22	90	72	482	94	87	39	58	53	54	52	84	18
23	79	88	394	66	76	40	54	56	54	28	22	55
24	88	75	369	64	96	44	33	56	54	61	32	52
25	88	57	325	105	78	46	54	55	22	37	96	18
26	93	71	299	82	37	44	54	54	53	59	82	28
27	87	50	245	72	72	49	50	55	53	52	20	54
28	85	76	218	76	66	48	50	34	55	49	53	53
29	85	.....	201	79	62	64	26	59	54	50	52	46
30	62	.....	195	78	53	59	44	59	51	46	20	15
31	96	.....	160	.....	73	.....	30	52	.....	61	.....	55

NOTE.—Daily discharge computed from a well-defined rating curve.

Monthly discharge of Cedar River near Austin, Minn., for 1909–10.

[Drainage area, 425 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
June	678	84	255	0.600	0.67	B.
July	181	37	66.8	.157	.18	A.
August	2,830	15	402	.946	1.09	B.
September	155	48	80.1	.188	.21	B.
October	122	34	71.0	.167	.19	A.
November	5,230	76	997	2.35	2.62	A.
December	926	68	232	.546	.63	B.
1910.						
January	169	40	99.7	.235	.27	B.
February	106	50	81.6	.192	.20	B.
March	2,070	75	636	1.50	1.73	B.
April	165	64	97.3	.229	.26	A.
May	107	28	67.9	.160	.18	A.
June	73	23	53.2	.125	.14	B.
July	73	26	50.7	.119	.14	B.
August	66	20	50.1	.118	.14	B.
September	63	22	51.1	.120	.13	B.
October	63	23	49.5	.116	.13	B.
November	96	18	49.5	.116	.13	B.
December	82	14	39.2	.092	.11	C.
The year	2,070	14	110	.260	3.56	

DES MOINES RIVER.

GENERAL FEATURES OF AREA DRAINED.

Des Moines River rises in the southern part of Minnesota, flows to the south and southeast diagonally across the State of Iowa, and enters the Mississippi near Keokuk, Iowa. Its principal tributaries are East Fork, which enters near Dakotah, in Humboldt County, and Raccoon River, which joins the main stream at Des Moines.

The total drainage area is 14,700 square miles. The area draining in above the Minnesota-Iowa line is 1,220 square miles; above the mouth of the Raccoon, 6,460 square miles. The drainage area of the Raccoon is 3,680 square miles.

The Des Moines throughout its course flows in a well-defined valley eroded for the most part in the glacial drift which covers the entire drainage basin. The depth of the valley increases from 50 to 150 feet, with a width of one-third to two-thirds of a mile between the top of the bluffs along the river. The entire area is within the prairie region and the only timber is found on the borders of the numerous lakes in the upper part of the basin or along the larger streams.

The annual rainfall is about 30 inches. From December to March the streams are frozen over entirely with ice 1 foot or more in thickness.

The Des Moines affords many sites for the development of water power. The lakes in the upper part of the basin aid in regulating the stream flow.

DES MOINES RIVER AT JACKSON, MINN.

This station, which is located at the highway bridge half a mile below the dam at Jackson, was established May 31, 1909, because of the power available on Des Moines River and also as part of the general plan for investigating the water resources of Minnesota.

The nearest tributary is a small stream that enters from the west at a point 300 feet below the station.

At the dam half a mile above the station is a power plant which develops 35 horsepower under a head of 6½ feet. The plant operates only six hours per day on the average, but thus far the morning and evening gage heights do not show any appreciable change in the stage of the river, owing to water being held back in low-water season after the turbines have been shut down.

From December to March observations are discontinued because of ice.

The datum of the gage has remained unchanged since the station was established. Conditions are favorable for good results and the records of flow should be reliable.

Discharge measurements of Des Moines River at Jackson, Minn., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 30	G. A. Gray	77	148	3.95	167
July 19	do	70	52.0	2.70	31.3

Daily gage height, in feet, of Des Moines River at Jackson, Minn., for 1910.

[Albert Strobel, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		4.72	3.84	3.08	2.86	2.65	2.60	2.71	2.64
2		4.66	3.79	2.91	3.01	2.64	2.60	2.60	2.78
3		4.60	3.79	2.94	2.81	2.61	2.58	2.68	2.78
4		4.59	3.69	3.02	2.79	2.61	2.60	2.58	2.75
5		4.50	3.69	2.82	2.78	2.59	2.60	2.58	2.72
6		4.39	3.68	2.75	2.78	2.59	2.59	2.64	2.60
7		4.24	3.65	2.78	2.74	2.61	2.58	2.62	2.60
8		4.29	3.60	2.78	2.70	2.61	2.56	2.58	2.70
9		4.28	3.59	3.00	2.72	2.61	2.66	2.58	2.58
10		4.21	3.49	3.62	2.70	2.62	2.65	2.58	2.56
11	6.68	4.16	3.51	3.85	2.78	2.61	2.52	2.54	2.78
12	7.18	4.10	3.50	3.75	2.82	2.60	2.60	2.60	2.72
13	7.30	4.05	3.51	3.54	2.72	2.62	2.70	2.80	2.75
14	7.79	4.00	3.44	3.45	2.72	2.64	2.60	2.75	2.68
15	7.52	4.01	3.40	3.12	2.85	2.62	2.60	2.59	2.64

Daily gage height, in feet, of Des Moines River at Jackson, Minn., for 1910—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	6.64	3.94	3.30	3.21	2.79	2.65	2.72	2.58	2.60
17	6.30	3.98	3.40	3.11	2.75	2.64	2.70	2.69	2.60
18	6.36	3.95	3.46	3.15	2.72	2.66	2.70	2.58	2.58
19	6.16	3.74	3.41	3.02	2.70	2.64	2.58	2.51	2.58
20	6.06	4.02	3.30	2.98	2.72	2.62	2.52	2.55	2.60
21	5.95	4.00	3.34	2.98	2.75	2.61	2.55	2.55	2.68
22	5.88	4.04	3.25	2.90	2.76	2.60	2.55	2.68	2.72
23	5.72	3.92	3.14	2.88	2.76	2.59	2.50	2.75	2.60
24	5.61	3.84	3.12	2.88	2.72	2.60	2.55	2.66	2.78
25	5.45	3.84	3.16	2.80	2.85	2.60	2.55	2.65	2.72
26	5.32	4.08	3.06	2.95	2.69	2.60	2.65	2.68	2.70
27	5.22	4.12	3.14	3.20	2.66	2.60	2.70	2.68	2.70
28	5.12	4.04	3.08	2.98	2.62	2.60	2.72	2.69	2.75
29	5.02	4.02	3.04	2.98	2.65	2.60	2.68	2.65	2.68
30	4.92	3.94	2.94	2.86	2.65	2.58	2.65	2.58	2.70
31	4.82	.....	2.98	.....	2.65	2.58	.....	2.56	.....

NOTE.—Ice present from Jan. 1 to Mar. 10 and from Dec. 1 to 31.

Daily discharge, in second-feet, of Des Moines River at Jackson, Minn., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	311	145	53	39	29	27	32	29
2	.....	299	138	42	48	29	27	27	35
3	.....	286	138	43	36	27	26	30	35
4	.....	284	122	48	36	27	27	26	34
5	.....	265	122	37	35	27	27	26	32
6	.....	243	121	34	35	27	27	29	27
7	.....	215	116	32	33	27	26	28	27
8	.....	224	109	35	31	27	25	26	31
9	.....	222	108	47	32	27	29	26	26
10	.....	209	94	112	31	28	29	26	25
11	777	200	96	147	35	27	24	25	35
12	909	189	95	132	37	27	27	27	32
13	941	180	96	101	32	28	31	36	34
14	1,070	172	87	88	32	29	27	33	30
15	1,000	174	82	56	38	28	27	27	29
16	766	162	71	63	36	29	32	26	27
17	678	169	82	55	34	29	31	30	27
18	694	164	90	58	32	29	31	26	26
19	642	130	83	48	31	29	26	23	26
20	616	175	71	46	32	28	24	25	27
21	588	172	75	46	34	27	25	25	30
22	570	179	66	41	34	27	25	30	32
23	532	158	57	40	34	27	23	33	27
24	505	145	56	40	32	27	25	29	35
25	468	145	59	36	38	27	25	29	32
26	439	186	51	44	31	27	29	30	31
27	417	193	57	62	29	27	31	30	31
28	395	179	53	46	28	27	32	31	34
29	374	175	50	46	29	27	30	29	30
30	353	162	43	39	29	26	29	26	31
31	332	.....	46	.....	29	26	.....	25	.....

NOTE.—Daily discharge computed from a well-defined rating curve.

Monthly discharge of Des Moines River at Jackson, Minn., for 1910.

[Drainage area, 1,160 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
March (11–31)	1,070	332	622	0.536	0.42	B.
April	311	130	199	.172	.19	A.
May	145	43	86.4	.074	.09	A.
June	147	32	57.2	.049	.05	A.
July	48	28	33.6	.029	.03	B.
August	29	26	27.5	.024	.03	B.
September	32	23	27.5	.024	.03	B.
October	36	23	28.1	.024	.03	B.
November	35	26	30.2	.026	.03	B.

ILLINOIS RIVER.

GENERAL FEATURES OF AREA DRAINED.

Illinois River enters the Mississippi from the east about 24 miles above the mouth of the Missouri. Its drainage area, comprising 29,000 square miles, is distributed among three States—Illinois, Wisconsin, and Indiana; 24,700 square miles are in Illinois, extending in a broad band 250 miles long and 100 miles in average width directly across the center of the State in a northeast-southwest direction; 1,080 square miles are in Wisconsin, extending north from the Illinois area; and 3,220 square miles are in Indiana, projecting east from the same area. The eastern projection is the basin of Kankakee River; the northern one contains the basins of Fox and Des Plaines rivers. The name Illinois is applied to the river from the junction of the Kankakee and Des Plaines.

The region drained by the Illinois is level or undulating, and includes some of the finest agricultural land in the United States. Many large and prosperous cities are situated within it, and it is covered with a network of railroads.

The drainage into the Illinois is rather evenly distributed along its course. The more important tributaries are Fox and Spoon rivers from the west, and the Vermilion and Sangamon from the east.

SANGAMON RIVER.

GENERAL FEATURES OF AREA DRAINED.

The drainage basin of Sangamon River lies wholly within the State of Illinois, very nearly in the center of the State. The river rises in the southwestern part of Ford County, flows southwestward to Decatur, in Macon County, thence westward to a point near Springfield, northwestward to its junction with Salt Creek at the northern boundary line of Menard County, and westward to its junction with

Illinois River at the northern boundary of Cass County. Springfield is about 20 miles southwest of the center of the basin, which is roughly a right triangle in shape, with the mouth of the river opposite the vertical. The river is about 180 miles long, not including bends. The total drainage area is 5,410 square miles. The principal tributaries are Salt Creek and South Fork.

The eastern third of the area is somewhat undulating and elevated; the rest is a level prairie. The soil is a very fertile, rich, black loam, especially adapted for raising corn. There are coal mines in the vicinity of Springfield. The bed and banks of the river are soft and insecure. The slope of the river is small. The elevation of its source is about 700 feet above sea level and that of its mouth is about 430 feet. The only timber in this drainage basin is in small groves or along the river banks.

The annual rainfall is about 37 inches. The winters are mild. Ice forms to some extent, and during severe winters attains considerable thickness.

The basin contains many swamp areas and is so level and low that little ground storage is available. High water follows every heavy rain, floods are of frequent occurrence and considerable duration, and as the banks of the river are low large areas are flooded. The drainage of the swamps and the opening up of channels so that flood waters may have an opportunity of returning quickly to the main stream makes the study of flood control and drainage of considerable importance. In some places short sections of the main stream are being straightened in an effort to provide a better channel so that floods will quickly drain off the adjacent land. Such work is of doubtful value, for in a few years at the most the river will return to its former channel or make new channels in order to keep in equilibrium. Any improvement of this kind should take into account the stream as a whole and should be begun at the lower end.

On account of the low slope, floods, low water, and lack of suitable foundations for dams, opportunities for development of water power are lacking.

SANGAMON RIVER NEAR MONTICELLO, ILL.

This station, which is located at the Illinois Central Railroad bridge about half a mile west of Monticello, Ill., was established February 4, 1908, for the purpose of collecting data to be used in studying drainage, water-supply, and flood-control problems.

No important tributaries enter near the station. The principal tributaries below the station are the South Fork of the Sangamon River and Salt Creek.

The relation between gage heights and discharge is somewhat affected by ice during portions of December, January, and February.

Discharge measurements are made from the railroad bridge and a trestle approach on the left bank.

The datum of the chain gage has not been changed; the records are reliable and accurate.

Discharge measurements of Sangamon River at Monticello, Ill., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar 11	M. E. McChristie	140	491	5.38	389
11	do	140	489	5.38	391
May 14	H. J. Jackson	161	1,010	8.86	1,200
27	do	152	773	7.46	767
28	do	144	670	6.74	634
Dec. 28	P. S. Monk	147	659	[a] 6.92	518

[a] Ice present.

Daily gage height, in feet, of Sangamon River near Monticello, Ill., for 1910.

[Martin Doyle, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.1	5.7	9.0	3.35	.....	6.3	4.05	.....	2.05	2.4	2.25	2.2
2	3.3	5.4	8.5	3.3	3.75	5.6	3.7	2.1	2.05	.....	2.25	2.2
3	3.35	5.9	7.4	.....	4.0	5.2	.....	2.05	2.0	2.35	2.25	2.2
4	3.35	6.1	6.6	3.35	4.2	4.9	3.3	2.0	.....	2.4	2.25	.....
5	3.35	6.2	6.5	3.35	4.0	.....	3.2	2.0	2.0	2.4	2.25	2.2
6	3.35	.....	.....	3.4	3.7	4.45	3.1	1.95	3.6	2.8	.....	2.2
7	3.35	5.15	6.9	3.3	3.85	4.25	3.0	.....	4.45	3.55	2.25	2.15
8	3.25	5.0	6.7	3.25	.....	4.0	2.85	1.95	6.0	3.4	2.25	2.15
9	.....	5.2	6.2	3.15	4.3	3.6	2.75	1.95	5.6	.....	2.25	2.15
10	3.1	4.8	5.75	.....	4.3	3.8	.....	1.9	4.3	3.0	2.2	2.15
11	3.1	4.6	5.4	3.1	4.3	3.65	2.6	1.9	.....	2.85	2.15	.....
12	3.15	4.1	5.2	3.1	4.4	.....	2.7	1.9	3.2	2.8	2.15	2.15
13	5.6	.....	.....	3.05	4.45	3.4	2.95	1.9	3.0	2.7	.....	2.05
14	8.35	4.25	4.8	3.0	4.3	3.3	3.6	.....	3.6	2.6	2.2	2.0
15	8.7	4.3	4.6	3.0	.....	3.2	3.3	1.85	3.2	2.55	2.2	2.05
16	.....	4.3	4.45	3.05	3.95	3.1	3.15	2.7	2.95	.....	2.2	2.0
17	7.7	3.6	4.3	.....	3.8	3.05	.....	2.8	2.75	2.55	2.2	2.0
18	9.5	4.3	4.25	3.2	3.7	3.0	2.8	3.4	.....	2.45	2.2	.....
19	9.7	4.9	4.15	3.2	3.6	.....	2.65	3.0	2.5	2.4	2.2	2.1
20	10.0	4.0	.....	3.15	3.65	2.8	2.5	2.5	2.5	2.4	.....	2.0
21	10.2	4.0	4.0	3.1	3.75	2.75	2.45	.....	2.4	2.4	2.2	2.0
22	10.2	4.0	3.95	3.1	.....	2.7	2.4	2.2	2.35	2.4	2.15	2.05
23	.....	3.9	3.85	3.1	7.2	2.6	2.35	2.2	.....	.....	2.15	2.1
24	9.65	3.8	3.8	.....	8.85	2.6	.....	2.3	2.4	2.3	2.15	2.0
25	8.7	3.6	3.7	3.1	9.45	2.5	2.2	2.15	.....	2.35	2.2	.....
26	7.7	3.95	3.7	3.2	9.15	.....	2.2	2.05	2.5	2.3	2.2	2.05
27	7.3	.....	.....	3.25	7.3	4.0	2.15	2.0	2.65	2.3	.....	2.05
28	7.2	9.45	3.7	3.4	6.8	6.45	2.15	.....	2.6	2.3	2.5	7.35
29	7.25	.....	3.6	3.75	.....	5.6	2.4	2.0	2.5	2.3	2.4	7.8
30	5.85	.....	3.6	3.7	6.4	4.6	2.3	2.0	2.5	.....	2.2	5.4
31	5.85	.....	.....	.....	6.7	.....	.....	2.0	.....	2.25	.....	5.1

NOTE.—Ice present from Jan. 1 to 17, ranging in thickness from 7 to 9 inches. Also ice from Feb. 17 to 28 and from Dec. 1 to 28. Gage read to top of ice for Jan. 1 to 17 and Feb. 17 to 28.

Daily discharge, in second-feet, of Sangamon River near Monticello, Ill., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	[a] 30	448	1,240	104	140	562	176	18	13	31	22	[b] 18
2	40	392	1,070	99	143	429	138	15	13	30	22	18
3	45	486	777	102	170	356	118	13	11	28	22	18
4	45	524	619	104	194	302	99	11	11	31	22	18
5	45	543	600	104	170	266	90	11	11	31	22	18
6	45	445	638	108	138	229	82	10	128	58	22	18
7	45	347	676	99	160	201	74	10	229	123	22	16
8	40	320	638	94	182	170	62	10	505	108	22	16
9	35	356	543	86	208	128	54	10	429	91	22	15
10	30	284	458	84	208	148	48	8	208	74	20	14
11	30	252	392	82	208	133	43	8	149	62	18	13
12	35	182	356	82	222	120	50	8	90	58	18	12
13	429	192	320	78	229	108	70	8	74	50	19	9
14	1,020	201	284	74	208	99	128	8	128	43	20	7
15	1,130	208	252	74	186	90	99	7	90	40	20	8
16	988	208	229	78	164	82	86	50	70	40	20	7
17	846	128	208	84	148	78	72	58	54	40	20	7
18	1,510	[c] 208	201	90	138	74	58	108	46	34	20	8
19	1,660	302	188	90	128	66	46	74	37	31	20	10
20	1,920	170	179	86	133	58	37	37	37	31	20	7
21	2,120	170	170	82	143	54	34	28	31	31	20	7
22	2,120	170	164	82	439	50	31	20	28	31	18	8
23	1,870	159	154	82	735	43	28	20	30	28	18	10
24	1,620	148	148	82	1,190	43	24	25	31	25	18	7
25	1,130	128	138	82	1,480	37	20	18	34	28	20	8
26	846	164	138	90	1,300	104	20	13	37	25	20	8
27	756	638	138	94	756	170	18	11	46	25	28	9
28	735	1,480	138	108	657	590	18	11	43	25	37	766
29	746	.....	128	143	629	429	31	11	37	25	31	870
30	476	.....	128	138	581	252	25	11	37	24	20	392
31	476	.....	121	.....	638	.....	22	11	.....	22	.....	338

[a] Daily discharge from Jan. 1 to 12 estimated, on account of presence of ice.
[b] Discharge from Dec. 1 to 27 has been partly estimated, on account of presence of ice in river.
[c] From Feb. 18 to 28 the daily discharge may be somewhat large on account of presence of ice.

NOTE.—Daily discharge computed from a rating curve well defined by measurements made in 1908, 1909, and 1910.

Monthly discharge of Sangamon River near Monticello, Ill., for 1910.

[Drainage area, 550 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	2,120	.....	738	1.32	1.52	B.
February	1,480	128	330	.600	.62	B.
March	1,240	121	369	.671	.77	A.
April	143	74	92.8	.169	.19	A.
May	1,480	128	388	.705	.81	A.
June	590	37	182	.331	.37	A.
July	176	18	61.3	.112	.13	A.
August	108	7	21.3	.039	.04	A.
September	505	11	89.6	.163	.18	A.
October	123	22	42.7	.078	.09	A.
November	37	18	21.4	.039	.04	A.
December	870	7	86.5	.157	.18	C.
The year	2,120	7	202	.349	4.94	

SANGAMON RIVER AT RIVERTON, ILL.

This station, which is located on the Wabash Railroad bridge about one-fourth mile west of the depot at Riverton, Ill., was established February 13, 1908, to obtain data to be used in the study of drainage and flood control problems.

The South Fork joins the Sangamon 2 or 3 miles above the station. Salt Creek and Crane Creek are tributaries below the station.

Relation between gage heights and discharge is slightly affected by ice during a portion of December, January, and February.

Discharge measurements are made from the railroad bridge, to which the chain gage is attached.

The datum of the gage has not been changed. The records are reliable and accurate.

The high water of 1883 reached a height representing approximately 32 feet on the present gage; the high water of 1875 is said to have been about one-half foot lower.

Discharge measurements of Sangamon River at Riverton, Ill., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 16	M. E. McChristie	179	1,190	11.88	1,220
May 16	H. J. Jackson	212	2,100	16.47	3,320
20	do	184	1,320	12.83	1,510
31	do	222	2,350	17.54	3,750
June 2	do	200	1,790	15.02	2,520
Dec. 23	P. S. Monk	146	534	8.18	228
24	do	140	476	7.82	167

Daily gage height, in feet, of Sangamon River at Riverton, Ill., for 1910.

[J. H. Steele, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10.0	13.8	17.4	10.0	10.6	16.55	12.7	9.2	8.55	8.75	8.1	12.25
2	10.0	13.3	18.1	9.95	10.45	15.1	11.9	8.8	8.2	8.7	8.05	12.25
3	10.1	13.0	18.5	9.0	10.8	14.2	11.1	8.6	7.8	8.45	8.1	12.25
4	10.5	12.9	19.0	9.0	14.6	13.5	10.7	8.4	7.85	8.6	7.95	12.0
5	10.5	12.85	19.3	10.2	15.15	12.9	11.6	8.25	7.8	8.6	7.95	11.15
6	10.25	12.8	19.0	10.4	14.6	12.7	12.2	8.1	7.75	8.85	8.0	9.85
7	10.2	12.7	18.1	10.6	13.95	12.5	11.5	8.0	8.0	9.7	7.95	9.55
8	10.2	12.6	17.1	10.4	13.9	12.1	11.6	7.9	8.5	9.9	8.0	8.65
9	10.3	12.4	16.0	10.2	14.5	11.7	10.9	8.0	11.15	10.4	8.0	8.9
10	10.5	12.1	15.1	10.0	14.55	12.0	10.1	7.9	11.4	10.55	7.95	8.75
11	10.4	12.0	14.2	9.9	14.5	13.1	9.7	7.8	11.75	10.25	7.95	8.55
12	10.1	11.8	13.6	9.8	16.75	11.6	9.6	7.75	11.7	9.9	7.95	8.45
13	10.8	11.7	13.0	9.7	18.0	11.0	10.2	7.7	11.2	9.45	7.95	8.35
14	14.5	11.2	12.6	9.6	17.8	10.65	10.4	7.65	10.35	9.2	8.0	8.4
15	15.9	11.1	12.2	9.6	17.0	10.5	11.0	7.55	9.5	8.95	7.95	8.25
16	16.2	11.2	12.0	9.5	16.6	10.4	12.5	7.7	8.85	8.85	7.75	8.25
17	16.0	10.7	11.8	10.05	15.6	10.3	14.7	7.75	8.7	8.7	7.45	8.25
18	18.4	9.8	11.5	10.4	14.8	10.0	13.8	7.9	8.5	8.55	7.45	8.25
19	20.2	10.2	11.4	11.0	13.6	9.8	12.6	10.0	8.35	8.5	7.4	8.3
20	21.05	10.7	11.2	11.05	12.9	9.7	11.4	9.65	8.2	8.35	7.35	8.15
21	21.2	10.8	11.1	10.7	12.6	10.1	10.5	9.9	8.05	8.25	7.35	7.85
22	21.0	10.5	11.0	10.45	13.2	9.6	9.95	9.85	8.0	8.3	7.35	7.8
23	21.0	10.55	10.9	10.2	14.25	9.3	9.5	9.8	7.9	8.15	7.35	7.95
24	20.7	10.3	10.8	10.0	17.8	9.2	9.3	9.8	7.95	8.3	7.4	7.9
25	20.3	10.1	10.7	9.9	19.5	9.1	9.1	9.85	8.4	8.35	7.35	7.9
26	19.8	10.4	10.5	9.9	20.05	9.1	8.9	9.6	8.45	8.25	7.35	7.9
27	19.1	13.2	10.4	10.05	20.2	10.2	8.7	8.95	8.45	8.3	7.85	7.9
28	18.5	15.9	10.3	10.4	19.9	14.8	8.6	8.6	9.15	8.25	13.25	8.2
29	17.0	.....	10.3	10.5	19.6	14.7	8.55	8.2	9.0	8.3	13.8	13.4
30	15.6	.....	10.3	10.65	19.2	13.4	8.5	7.95	8.9	8.15	13.35	15.7
31	14.5	.....	10.1	.....	18.1	.....	9.0	7.9	.....	8.15	.....	15.2

NOTE.—Practically no ice present at this station during 1910 except during the first few days of January.

Daily discharge, in second-feet, of Sangamon River at Riverton, Ill., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	300	2,000	4,010	603	792	3,520	1,540	388	262	296	202	1,370
2	400	1,790	4,430	588	744	2,700	1,240	305	214	287	196	1,370
3	500	1,660	4,690	344	856	2,210	955	270	168	247	202	1,370
4	760	1,620	5,040	344	2,430	1,870	824	240	173	270	184	1,280
5	760	1,600	5,260	665	2,730	1,620	1,130	220	168	270	184	972
6	680	1,580	5,040	728	2,430	1,540	1,350	202	163	314	190	557
7	665	1,540	4,430	792	2,080	1,460	1,100	190	190	513	184	473
8	665	1,500	3,840	728	2,050	1,310	1,130	179	254	572	190	278
9	696	1,420	3,200	665	2,380	1,170	888	190	972	728	190	324
10	760	1,310	2,700	603	2,400	1,280	634	179	1,060	776	184	296
11	728	1,280	2,210	572	2,380	1,710	513	168	1,180	680	184	262
12	634	1,200	1,920	542	3,640	1,130	486	163	1,170	572	184	247
13	856	1,170	1,660	513	4,370	920	665	158	990	448	184	234
14	2,380	990	1,500	486	4,250	808	728	153	712	388	190	240
15	3,140	955	1,350	486	3,780	760	920	143	460	334	184	220
16	3,320	990	1,280	460	3,550	728	1,460	158	314	314	163	220
17	3,200	824	1,200	618	2,980	696	2,480	163	287	287	133	220
18	4,620	542	1,100	728	2,540	603	2,000	179	254	262	133	220
19	6,020	665	1,060	920	1,920	542	1,500	603	234	254	128	227
20	6,870	824	990	938	1,620	513	1,060	500	214	234	123	208
21	7,020	856	955	824	1,500	634	760	572	196	220	123	174
22	6,820	760	920	744	1,750	486	588	557	190	227	123	168
23	6,820	776	888	665	2,240	411	460	542	179	208	123	184
24	6,520	696	856	603	4,250	388	411	542	184	227	128	179
25	6,120	634	824	572	5,420	366	366	557	240	234	123	179
26	5,660	728	760	572	5,880	366	324	486	247	220	123	179
27	5,120	1,750	728	618	6,020	665	287	334	247	227	174	179
28	4,690	3,140	696	728	5,740	2,540	270	270	377	220	1,770	214
29	3,780	.....	696	760	5,500	2,480	262	214	344	227	2,000	1,830
30	2,980	.....	696	808	5,190	1,830	254	184	324	208	1,810	3,040
31	2,380	.....	634	.....	4,430	.....	344	179	.....	208	.....	2,760

NOTE.—Daily discharge computed from a fairly well-defined rating table based on measurements made, 1908–1910. Discharge for Jan. 1, 2, 3 was estimated on account of ice.

Monthly discharge of Sangamon River at Riverton, Ill., for 1910.

[Drainage area, 2,560 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	7,020	.....	3,090	1.21	1.40	B.
February	3,140	634	1,240	.484	50	B.
March	5,260	634	2,110	.824	.95	B.
April	938	344	641	.250	.28	B.
May	6,020	744	3,160	1.23	1.42	B.
June	3,520	366	1,240	.484	.54	B.
July	2,480	254	869	.339	.39	B.
August	603	143	296	.115	.13	B.
September	1,180	163	399	.156	.17	B.
October	776	208	338	.132	.15	B.
November	2,000	123	334	.131	.15	B.
December	3,040	168	635	.248	.29	C.
The year	7,020	123	1,200	.469	6.37	

SANGAMON RIVER NEAR OAKFORD, ILL.

This station, which is located at the highway bridge about 3 miles northeast of Oakford, Ill., and about 2½ miles upstream from the Chicago, Peoria & St. Louis Railway bridge, was established October 26, 1909, for the purpose of obtaining data for use in studying problems of drainage and flood control.

Crane Creek enters on the right bank about 1¼ miles below, and Salt Creek, also on the right bank, about 6¼ miles above the section. Other tributaries are South Fork of the Sangamon River and Sugar Creek.

Discharge measurements are made from the bridge and the trestle approaches at each end.

The datum of the chain gage has remained unchanged since the gage was installed. Because of the inaccessibility of the gage it has not been possible to procure daily readings, but the records obtained are accurate and reliable.

The relation between gage heights and discharge is affected somewhat by ice in December, January, and February.

The floods of February and March, 1907, and May, 1908, reached a height of about 21 feet on the present gage.

For stages below gage height of 3 feet the discharge table should be used with caution.

Discharge measurements of Sangamon River near Oakford, Ill., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 17	M. E. McChristie	255	1,300	6.03	2,260
28	H. J. Jackson	241	913	4.71	1,510
May 18	do	277	1,800	8.26	4,180
21	do	261	1,310	6.50	2,740
June 1	do	324	2,760	11.30	7,130
3	do	280	1,910	8.57	4,310
Dec. 26	P. S. Monk	125	248	1.94	342

Daily gage height, in feet, of Sangamon River near Oakford, Ill., for 1910.

[Ed. J. Bonnett, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	9.15	10.4	4.3	5.0	11.25	6.3	2.2	2.4	2.5	1.75	4.45
2	.....	.....	10.5	4.25	4.95	10.0	5.85	2.8	2.4	2.4	1.7	4.35
3	.....	8.25	10.45	4.2	4.8	8.75	5.4	2.9	2.6	2.35	1.7	4.05
4	.....	.....	10.5	4.2	5.0	8.0	4.1	2.4	3.0	2.3	1.7	4.5
5	.....	7.95	10.6	4.3	6.65	7.4	4.4	2.4	4.2	2.35	1.7	4.3
6	.....	.....	.....	4.45	7.3	6.9	4.4	2.4	4.2	2.8	1.7	3.9
7	.....	7.25	.....	4.9	7.1	6.6	4.4	2.4	4.2	2.9	1.65	3.1
8	.....	.....	10.7	4.7	7.0	6.3	4.4	2.5	4.4	3.5	1.6	2.75
9	.....	.....	10.05	4.5	6.9	6.0	4.5	2.6	4.2	3.5	1.6	2.7
10	.....	6.95	9.3	4.35	7.05	6.0	4.2	2.4	4.2	.....	1.6	2.75
11	.....	.....	.....	4.2	7.3	6.5	4.0	2.0	4.2	3.35	1.55	2.65
12	.....	6.5	.....	4.1	7.65	6.45	3.8	2.0	4.2	3.25	1.55	2.45
13	.....	.....	7.3	4.0	8.5	5.6	3.6	1.8	4.2	3.2	1.6	2.45
14	.....	5.7	.....	4.0	9.3	5.15	3.55	1.7	4.2	2.95	1.6	2.3
15	9.4	.....	6.65	3.95	9.35	4.85	3.5	1.6	4.2	2.85	1.65	2.25
16	.....	5.85	.....	4.0	9.2	4.6	4.4	1.8	4.4	2.6	1.65	2.2
17	10.9	.....	6.05	4.2	8.75	4.5	5.6	1.7	4.6	2.5	1.55	2.05
18	11.7	5.0	.....	4.45	8.5	4.3	6.2	2.9	4.0	2.4	1.7	2.1
19	12.6	4.5	5.7	4.7	7.65	4.1	6.1	2.2	3.6	2.3	1.75	2.1
20	13.0	.....	.....	4.8	6.95	4.0	5.1	2.4	3.0	2.2	1.7	2.1
21	.....	5.3	5.4	4.9	6.5	3.85	4.6	2.7	.....	2.2	1.7	2.1
22	14.35	.....	.....	4.75	6.3	3.95	4.15	3.0	2.2	2.1	1.65	2.1
23	.....	4.8	.....	4.55	6.6	4.0	3.7	3.1	2.2	2.05	1.6	2.0
24	.....	4.7	5.2	4.4	7.65	3.85	3.7	3.4	2.15	2.0	1.6	1.9
25	.....	4.75	5.0	4.35	9.5	4.0	3.8	3.2	2.2	1.95	1.6	1.9
26	14.2	.....	4.9	4.35	10.4	4.05	3.0	3.0	2.55	1.9	1.65	1.9
27	13.8	.....	.....	4.35	10.8	4.8	2.9	3.2	2.5	1.9	1.75	1.8
28	.....	7.75	4.7	4.85	11.0	7.0	2.8	2.7	2.55	1.9	2.4	2.15
29	13.0	.....	4.6	5.05	11.2	7.0	2.7	2.2	2.65	1.85	4.05	2.4
30	.....	.....	4.55	4.95	11.5	7.0	2.4	2.0	2.65	1.85	4.75	4.8
31	10.0	.....	4.4	.....	11.9	.....	2.3	2.4	.....	1.8	.....	6.5

NOTE.—Ice present Jan. 1 to 17.

Daily discharge, in second-feet, of Sangamon River near Oakford, Ill., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4,910	6,200	1,290	1,670	7,120	2,540	450	520	555	292	1,360
2	.....	4,500	6,300	1,260	1,640	5,780	2,220	660	520	520	275	1,320
3	.....	4,080	6,250	1,240	1,560	4,540	1,910	700	590	502	275	1,170
4	.....	3,950	6,300	1,240	1,670	3,860	1,200	520	740	485	275	1,390
5	.....	3,820	6,410	1,290	2,810	3,380	1,340	520	1,240	502	275	1,290
6	.....	3,540	6,450	1,360	3,300	3,000	1,340	520	1,240	660	275	1,100
7	.....	3,260	6,480	1,610	3,150	2,770	1,340	520	1,240	700	258	780
8	.....	3,180	6,520	1,500	3,070	2,540	1,340	555	1,340	940	240	642
9	.....	3,110	5,830	1,390	3,000	2,320	1,390	590	1,240	940	240	625
10	.....	3,030	5,060	1,320	3,110	2,320	1,240	520	1,240	910	240	642
11	.....	2,860	4,470	1,240	3,300	2,700	1,150	380	1,240	880	222	608
12	.....	2,700	3,890	1,200	3,580	2,660	1,060	380	1,240	840	222	538
13	.....	2,400	3,300	1,150	4,310	2,040	980	310	1,240	820	240	538
14	.....	2,110	3,060	1,150	5,060	1,760	960	275	1,240	720	240	485
15	.....	2,160	2,810	1,130	5,110	1,580	940	240	1,240	680	258	468
16	.....	2,220	2,580	1,150	4,960	1,440	1,340	310	1,340	590	258	450
17	6,740	1,940	2,360	1,240	4,540	1,390	2,040	275	1,440	555	222	398
18	7,640	1,670	2,240	1,360	4,310	1,290	2,470	700	1,150	520	275	415
19	8,720	1,390	2,110	1,500	3,580	1,200	2,400	450	980	485	292	415
20	9,210	1,620	2,010	1,560	3,030	1,150	1,730	520	740	450	275	415
21	10,100	1,850	1,910	1,610	2,700	1,080	1,440	625	595	450	275	415
22	11,000	1,700	1,870	1,530	2,540	1,130	1,130	740	450	415	258	415
23	11,000	1,560	1,830	1,420	2,770	1,150	1,020	780	450	398	240	380
24	10,900	1,500	1,790	1,340	3,580	1,080	1,020	900	432	380	240	345
25	10,800	1,530	1,670	1,320	5,260	1,150	1,060	820	450	362	240	345
26	10,800	2,240	1,610	1,320	6,200	1,170	740	740	572	345	258	345
27	10,200	2,950	1,560	1,320	6,630	1,560	700	820	555	345	292	310
28	9,700	3,660	1,500	1,580	6,850	3,070	660	625	572	345	520	432
29	9,210	.....	1,440	1,700	7,070	3,070	625	450	608	328	1,170	520
30	7,500	.....	1,420	1,640	7,400	3,070	520	380	608	328	1,530	1,560
31	5,780	.....	1,340	.....	7,880	.....	485	520	.....	310	.....	2,700

NOTE.—Discharge interpolated for days of missing gage heights.

Monthly discharge of Sangamon Rievr near Oakford, Ill., for 1910.

[Drainage area, 5,000 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January (17-31)	11,000	5,780	9,290	1.860	1.04	C.
February	4,910	1,390	2,690	.538	.56	B.
March	6,520	1,340	3,500	.700	.81	B.
April	1,700	1,130	1,370	.274	.31	A.
May	7,880	1,560	4,050	.810	.93	A.
June	7,120	1,080	2,410	.482	.54	A.
July	2,540	485	1,300	.260	.30	A.
August	900	240	542	.108	.12	A.
September	1,440	432	902	.180	.20	A.
October	940	310	557	.111	.13	A.
November	1,530	222	339	.068	.08	A.
December	2,700	310	736	.147	.17	B.
The period	11,000	222	2,000	.400	5.19	

SOUTH FORK OF SANGAMON RIVER NEAR TAYLORVILLE, ILL.

This station, which is located at the Wabash Railroad bridge about 3½ miles southwest of Taylorville, Ill., and about one-fourth mile upstream from the highway bridge across the South Fork known as the Half Acre Bridge, was established February 11, 1908, for the purpose of obtaining data for use in studying drainage, flood control, and water-supply problems.

Bear Creek, a small tributary, enters the stream on the left bank a few miles below the station.

In August, 1909, a drainage ditch was dug along the river in this vicinity, straightening the course of the stream but coinciding with the original channel at the gaging station. The cross section of the stream at the gaging station was not altered, but the relation between gage height and discharge was materially changed as the result of the change in slope. The new channel may shift to some extent. The gage heights to August 10, 1909, inclusive, refer to the section before the change; gage heights from August 11 to September 1, 1909, inclusive, are of no value, because the stream was dammed up for purposes of construction during that period. On September 2, 1909, the datum of the chain gage was lowered 2 feet, and the gage heights from that date on refer to the new conditions. In making comparisons between the data for the original and the new conditions it should be noted that the gage datum has been changed.

The records are accurate and reliable.

The relation between gage heights and discharge is liable to be affected by ice in January, February, and December.

Discharge measurements of South Fork of Sangamon River near Taylorville, Ill., in 1910.

Date.	Hydrographer.	Width	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 15	M. E. McChristie	66	275	4.91	154
15	do	66	278	4.88	159
18	do	64	248	4.66	133
May 12	H. J. Jackson	271	1,050	9.48	923
14	do	273	1,240	9.97	1,220
17	do	128	491	7.28	339
19	do	86	351	6.02	262
20	do	76	320	5.62	202
24	do	274	1,260	10.14	1,260
July 19	do	62	276	4.90	171
Dec. 22	P. S. Monk	68	201	[a] 3.30	58

[a] Ice present.

Daily gage height, in feet, of South Fork of Sangamon River near Taylorville, Ill., for 1910.

[Joseph Ethridge, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.25	4.5	10.95	3.8	3.05	7.05	.....	2.55	1.9	2.15	2.65	9.9
2	4.55	4.55	10.7	3.65	4.7	5.9	.....	2.5	2.0	2.9	2.5	9.5
3	4.75	4.95	10.25	3.4	7.85	5.7	.....	2.4	2.0	2.7	2.6	7.95
4	4.85	5.4	9.95	3.2	8.7	5.85	.....	2.35	2.1	3.8	2.45	5.85
5	4.95	5.5	9.6	3.9	8.8	6.0	.....	2.3	2.3	3.45	2.4	5.1
6	5.4	5.4	9.15	3.65	8.15	5.65	.....	2.2	4.05	4.55	2.65	4.7
7	5.9	5.2	9.0	3.3	7.95	5.2	.....	2.1	8.55	5.95	2.7	4.4.
8	6.0	4.95	8.1	3.1	8.0	4.8	.....	2.2	8.75	6.95	2.7	3.9
9	6.2	4.7	7.75	3.05	8.4	4.9	.....	2.25	8.5	6.3	2.65	3.6
10	6.35	4.45	7.1	3.15	8.25	4.45	.....	2.2	8.55	4.85	2.7	4.1
11	6.85	4.2	6.8	3.3	9.15	4.0	.....	2.25	8.4	4.25	2.65	3.95
12	7.05	3.85	6.05	3.35	9.6	3.95	.....	2.05	7.05	3.8	2.7	4.1
13	8.0	3.8	5.5	3.9	10.2	3.8	.....	2.00	4.4	3.6	2.65	3.65
14	8.8	3.75	5.1	4.0	9.95	3.9	.....	1.95	3.6	3.45	2.7	3.5
15	9.7	3.65	4.95	4.1	9.05	3.8	.....	1.95	3.5	3.25	2.75	3.45

Daily gage height, in feet, of South Fork of Sangamon River near Taylorville, Ill., for 1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	10.0	3.55	4.8	4.35	8.45	3.7	.....	1.9	3.05	3.2	2.65	3.5
17	10.1	3.7	4.75	5.95	7.4	3.7	.....	2.0	2.85	3.0	2.65	3.45
18	10.45	3.7	4.7	6.75	6.75	3.2	.....	3.7	2.75	3.05	2.7	3.45
19	10.7	3.9	4.55	7.05	5.85	3.2	5.1	4.6	2.65	3.0	2.7	3.45
20	11.0	3.95	4.6	6.6	5.4	3.2	4.3	5.35	2.6	2.85	2.65	3.2
21	10.85	4.2	4.7	5.9	6.85	3.1	3.85	5.45	2.55	2.8	2.7	3.25
22	10.25	4.25	4.65	4.95	8.4	3.1	3.6	6.8	2.5	2.85	2.65	3.25
23	9.35	3.9	4.5	3.9	10.25	3.1	3.4	7.35	2.45	3.0	2.7	2.9
24	8.65	3.8	4.45	3.65	9.9	3.05	3.25	5.85	2.7	2.95	2.65	2.95
25	7.3	3.85	4.3	3.5	11.0	3.1	3.1	3.95	2.85	2.85	2.6	3.15
26	6.75	4.2	4.2	3.15	10.85	3.2	3.0	2.95	3.2	2.95	2.65	3.15
27	6.35	8.9	4.05	3.0	10.3	3.5	2.9	2.45	3.95	2.85	6.25	3.15
28	6.0	10.0	4.0	3.4	9.45	3.45	2.8	2.25	3.25	2.8	7.95	6.8
29	5.45	.....	3.9	3.5	8.65	3.15	2.8	2.2	4.2	2.7	9.15	8.1
30	5.05	.....	3.9	3.2	8.0	3.0	2.9	2.15	3.55	2.65	9.9	8.7
31	4.95	.....	3.85	.....	7.6	.....	2.7	1.95	.....	2.75	.....	9.15

NOTE.—Ice was probably present during portions of January and February. Ice present from Dec. 13 to 17, Dec. 23 to 27, and readings taken to top of ice.

Daily discharge, in second-feet, of South Fork of Sangamon River near Taylorville, Ill., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	112	127	1,670	87	52	338	54	32	13	20	36	1,150
2	130	130	1,540	80	140	234	54	30	15	46	30	950
3	144	158	1,320	67	432	217	54	27	15	38	34	447
4	150	193	1,170	58	606	230	54	26	18	87	28	230
5	158	201	999	92	638	243	54	24	24	70	27	169
6	193	193	782	80	481	213	54	21	100	130	36	140
7	234	177	714	62	447	177	54	18	566	238	38	121
8	243	158	472	54	455	147	54	21	622	328	38	92
9	261	140	417	52	530	154	54	22	553	270	36	77
10	274	124	343	56	500	124	54	21	566	150	38	103
11	320	109	315	62	782	97	54	22	530	112	36	94
12	338	90	248	64	999	94	121	16	338	87	38	103
13	455	87	201	92	1,300	87	217	15	121	77	36	64
14	638	84	169	99	1,170	92	353	14	77	70	38	58
15	1,050	80	158	103	736	87	553	14	72	60	40	56
16	1,200	74	147	150	542	82	638	13	52	58	36	58
17	1,240	82	144	238	374	82	397	15	44	50	36	56
18	1,420	82	140	310	310	58	279	82	40	52	38	70
19	1,540	92	130	338	230	58	169	133	36	50	38	70
20	1,700	94	133	297	193	58	115	189	34	44	36	58
21	1,620	109	140	234	320	54	90	197	32	42	38	60
22	1,320	112	136	158	530	54	77	315	30	44	36	60
23	877	92	127	92	1,320	54	67	368	28	50	38	37
24	592	87	124	80	1,150	52	60	230	38	48	36	38
25	363	90	115	72	1,700	54	54	94	44	44	34	45
26	310	109	109	56	1,620	58	50	48	58	48	36	45
27	274	674	100	50	1,340	72	46	28	94	44	266	45
28	243	1,200	97	67	926	70	42	22	60	42	447	315
29	197	.....	92	72	592	56	42	21	109	38	782	472
30	165	.....	92	58	455	50	46	20	74	36	1,150	606
31	158	.....	90	.....	397	.....	38	14	.....	40	.....	782

NOTE.—Daily discharge computed from a well-defined rating table based on measurements made in 1908–1910. It is possible that the discharges during January and February may be somewhat large owing to presence of ice. Daily discharge from July 1 to 18, inclusive, has been estimated from known high-water stage which occurred July 16. Daily discharge from Dec. 13 to 17 and from Dec. 23 to 27 reduced 20 per cent on account of ice.

Monthly discharge of South Fork of Sangamon River near Taylorville, Ill., for 1910.

[Drainage area, 427 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	1,700	112	578	1.35	1.56	C.
February	1,200	74	177	.415	.43	A.
March	1,670	90	401	.939	1.08	A.
April	338	50	113	.265	.30	B.
May	1,700	52	686	1.61	1.86	A.
June	338	50	115	.269	.30	B.
July	638	38	131	.307	.35	C.
August	368	13	68.1	.160	.18	A.
September	622	13	147	.344	.38	A.
October	328	20	81.1	.190	.22	A.
November	1,150	27	38.3	.090	.10	A.
December	1,150	37	215	.504	.58	B.
The year	1,700	13	231	.541	7.34	

SALT CREEK NEAR KENNEY, ILL.

Salt Creek is a tributary of Sangamon River.

The gaging station, which is located at the highway bridge about 2 miles west of Kenney, Ill., about three-fourths of a mile below the Vandalia Railroad bridge, was established February 14, 1908, to collect data for use in the study of drainage and flood-control problems.

Tenmile Creek enters on the right bank about 4 miles above the gaging station. Other tributaries of Salt Creek are North and Lake forks and Deer, Sugar, Prairie, and Pike creeks.

The chain gage is attached to the bridge; its datum has not been changed.

The relation between gage heights and discharge is somewhat affected by ice in December, January, and February.

The records are reliable and accurate, but low-water measurements should be used with caution.

The high water of 1882 is said to have been about 1 or 1½ feet higher than that of the spring of 1908, or to have reached a height of about 16 feet on the present gage.

Discharge measurements of Salt Creek near Kenney, Ill., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 9	M. E. McChristie	111	300	3.43	355
May 25	H. J. Jackson	112	344	3.96	438
25	do	112	349	3.94	454
Dec. 27	P. S. Monk	78	51.4	[a] 1.25	10.7

[a] Ice present.

Daily gage height, in feet, of Salt Creek near Kenney, Ill., for 1910.

[Chris McDermott, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.35	3.0	5.5	2.15	2.35	2.75	1.65	1.45	1.2	1.45	1.35	1.6
2	2.35	3.5	4.4	2.1	2.35	2.5	1.6	1.4	1.2	1.4	1.3	1.5
3	2.5	3.6	3.7	2.15	2.9	2.4	1.6	1.3	1.2	1.35	1.3	1.3
4	2.5	3.6	3.7	2.15	2.75	2.35	1.55	1.25	1.3	1.8	1.25	1.3
5	2.45	3.5	3.8	2.45	2.6	2.3	1.5	1.25	1.25	2.5	1.3	1.4
6	2.4	3.3	3.9	2.35	2.45	2.2	1.5	1.2	1.3	2.4	1.25	1.4
7	2.3	3.25	3.95	2.25	2.45	2.2	1.5	1.2	2.05	2.3	1.25	1.3
8	2.25	3.2	3.65	2.15	2.65	2.1	1.5	1.2	1.8	2.1	1.3	1.35
9	2.25	3.1	3.45	2.15	2.7	2.05	1.45	1.2	1.95	2.0	1.3	1.3
10	2.2	2.85	3.2	2.1	2.75	2.0	1.45	1.2	1.9	1.85	1.3	1.2
11	2.2	2.7	3.15	2.05	2.8	2.0	1.4	1.2	1.75	1.8	1.3	1.15
12	2.3	2.95	3.0	2.05	2.95	1.9	1.4	1.2	1.65	1.7	1.35	1.2
13	3.7	2.4	2.95	2.05	2.85	1.85	2.0	1.15	1.6	1.65	1.25	1.2
14	5.6	2.7	2.85	2.0	2.7	1.8	1.9	1.15	1.5	1.6	1.3	1.2
15	5.8	2.8	2.7	2.05	2.55	1.8	1.9	1.15	1.5	1.55	1.25	1.15
16	5.55	2.6	2.85	2.05	2.45	1.75	2.05	1.2	1.45	1.5	1.35	1.2
17	5.2	2.4	2.6	2.25	2.45	1.75	1.7	3.6	1.35	1.5	1.3	1.25
18	7.6	2.4	2.55	2.25	2.4	1.7	1.6	2.2	1.3	1.45	1.4	1.3
19	7.65	2.6	2.5	2.2	2.3	1.7	1.5	1.7	1.3	1.4	1.2	1.3
20	8.1	2.45	2.45	2.2	2.35	1.65	1.5	1.8	1.25	1.35	1.25	1.2
21	8.85	2.5	2.45	2.2	2.35	1.6	1.45	1.6	1.25	1.4	1.25	1.3
22	8.8	2.5	2.4	2.15	2.3	1.6	1.45	1.6	1.15	1.4	1.25	1.3
23	8.05	2.7	2.35	2.15	3.75	1.6	1.35	1.5	1.2	1.35	1.3	1.2
24	6.9	2.65	2.35	2.15	3.95	1.55	1.3	1.4	1.45	1.35	1.35	1.15
25	6.1	2.2	2.25	2.15	3.75	1.5	1.3	1.35	1.6	1.4	1.35	1.20
26	5.4	2.3	2.25	2.2	3.65	1.5	1.25	1.35	1.65	1.6	1.3	1.25
27	5.15	5.7	2.3	2.55	3.15	2.05	1.25	1.3	1.6	1.45	1.6	1.25
28	4.35	6.1	2.3	2.7	2.8	1.85	2.2	1.25	1.55	1.4	1.75	4.0
29	4.1	.....	2.25	2.55	3.0	1.75	2.05	1.2	1.5	1.15	1.6	4.7
30	3.85	.....	2.2	2.45	3.0	1.7	1.6	1.2	1.45	1.15	1.65	4.0
31	3.65	.....	2.15	.....	3.0	.....	1.5	1.2	.....	1.25	.....	3.15

NOTE.—Ice present from Jan. 1 to 27, Feb. 17 to 28, and also from Dec. 11–16 and 20 to 27. From Jan. 1 to 27, Dec. 11 to 16, 20 to 27, and 30 to 31 the gage heights were read to the top of ice.

Daily discharge, in second-feet, of Salt Creek near Kenney, Ill., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8	208	933	60	88	158	26	16	10	16	14	23
2	8	326	584	54	88	112	23	15	10	15	12	18
3	7	352	379	60	187	96	23	12	10	14	12	12
4	7	352	379	60	158	88	20	11	12	34	11	12
5	7	326	407	104	129	81	18	11	11	117	12	15
6	6	277	436	88	104	67	18	10	12	102	11	15
7	6	265	450	74	104	67	18	10	58	88	11	12
8	7	253	366	60	138	54	18	10	34	64	12	14
9	6	230	314	60	148	48	16	10	48	53	12	12
10	7	177	253	54	158	43	16	10	42	38	12	10
11	30	148	242	48	167	43	15	10	31	34	12	9
12	40	198	208	48	198	33	15	10	26	28	14	9
13	200	96	198	48	177	29	53	9	23	26	11	9
14	500	148	177	43	148	25	42	9	18	23	12	9
15	700	167	148	48	120	25	42	9	18	20	11	9
16	600	129	177	48	104	22	58	10	16	18	14	10
17	600	50	129	74	104	22	28	352	14	18	12	11
18	1,000	20	120	74	96	18	23	75	12	16	15	12
19	1,000	25	112	67	81	18	18	28	12	15	10	12
20	1,500	40	104	67	88	16	18	34	11	14	11	11
21	2,000	50	104	67	88	14	16	23	11	15	11	11
22	1,800	35	96	60	81	14	16	23	9	15	11	11
23	1,500	10	88	60	393	14	14	18	10	14	12	11
24	1,300	10	88	60	450	12	12	15	16	14	14	10
25	1,000	10	74	60	393	10	12	14	23	15	14	10
26	600	15	74	67	366	10	11	14	26	23	12	11
27	600	500	81	120	242	48	11	12	23	16	23	11
28	539	700	81	148	167	29	75	11	20	15	31	465
29	494	.....	74	120	208	22	58	10	18	9	23	676
30	422	.....	67	104	208	18	23	10	16	9	26	220
31	366	.....	60	.....	208	.....	18	10	.....	11	.....	150

NOTE.—Daily discharge computed from two rating tables fairly well defined and based on measurements made 1908–1910.

From Jan. 1 to 27, Feb. 17 to 28, and from Dec. 11 to 16, Dec. 21 to 27, and Dec. 30 and 31 the discharges were estimated on account of presence of ice.

Monthly discharge of Salt Creek near Kenney, Ill., for 1910.

[Drainage area, 459 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	2,000	6	544	1.19	1.37	D.
February	700	10	183	.399	.42	B.
March	933	60	226	.492	.57	B.
April	148	43	70.2	.153	.17	B.
May	450	81	174	.379	.44	B.
June	158	10	41.9	.091	.10	B.
July	58	11	25.0	.054	.06	B.
August	352	9	26.5	.058	.07	B.
September	58	9	20.0	.044	.05	C.
October	117	9	29.3	.064	.07	C.
November	31	10	13.9	.030	.03	C.
December	676	.....	59.0	.129	.15	D.
The year	2,000	6	118	.257	3.50	

CAHOKIA CREEK.

GENERAL FEATURES OF AREA DRAINED.

The drainage area of Cahokia Creek lies in the southwestern part of the State of Illinois. The creek rises in the southern part of and about on line between Montgomery and Macoupin counties, flows in a southwesterly direction diagonally across the southeast corner of Macoupin County and the northwest portion of Madison County, past Edwardsville, through East St. Louis, Ill., and empties into Mississippi River.

The creek is very crooked and its length is approximately 55 miles. Its basin is about 45 miles long, 8 miles in average width, and 12 miles maximum width, and comprises 360 square miles. Its principal tributary, Indian Creek, enters from the right bank about three-fourths of a mile north of the Wabash Railroad bridge near Poag, Ill. The area drained is low, level, or undulating, and is crossed by a chain of bluffs just north of Poag, Ill. The sources of the creek are about 680 feet and the mouth about 385 feet above sea level.

The area contains no forested tracts. The mean annual rainfall is about 40 inches. In general the winters are mild. The opportunities for storage and water-power development have not been investigated but are undoubtedly not worthy of consideration. Flood control, especially in its relation to the proposed flood protection works of the East Side levee and sanitary district of East St. Louis, Ill., is the most important problem under consideration at present in connection with this drainage basin.

CAHOKIA CREEK NEAR POAG, ILL.

This station, which is located at the Wabash Railroad bridge about three-fourths of a mile northeast of the Wabash Railroad station at Poag, Ill., was established December 13, 1909. The data collected will be used by the East Side levee and sanitary district of East St. Louis, Ill., in its study of flood control and prevention at that place.

Indian Creek enters on the right bank about three-fourths of a mile above the section.

The relation between gage heights and discharge is apt to be affected by ice in December, January, and February.

The datum of the gage has remained unchanged since the installation of the gage.

The records are accurate and reliable.

Discharge measurements of Cahokia Creek near Poag, Ill., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec. ft.*
Mar. 21	Jackson and McChristie	48	108	3.43	50
24	H. J. Jackson	47	101	3.33	46
Apr. 13	....do	47	96	3.10	44
May 3	Morgan and Livingston	89	716	12.45	1,100
24	W. H. Morgan	115	847	13.53	1,320
Sept. 6	....do	96	772	12.70	1,030
7	....do	73	491	9.30	530
8	....do	63	310	7.08	256
9	....do	60	216	5.32	132
Oct. 7	....do	247	1,730	16.25	[a] 2,890
Dec. 9	Bailey and Monk	45	82.5	[b] 2.99	10

[a] Includes 574 second-feet in flood channel. [b] Ice present.

Daily gage height, in feet, of Cahokia Creek near Poag, Ill., for 1910.

[S. T. Sanders, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.5	2.3	16.6	2.9	3.3	4.2	2.4	2.4	6.0	3.7	3.35	5.95
2	3.2	2.3	14.5	2.8	8.8	3.5	2.3	2.3	3.2	3.3	3.4	5.1
3	3.6	4.0	12.3	3.1	12.8	3.4	3.7	2.3	2.3	2.95	3.6	4.15
4	4.0	5.0	9.0	3.2	10.3	12.1	3.0	2.2	13.0	5.3	3.85	4.2
5	5.0	4.2	6.6	6.4	6.1	13.2	2.8	2.1	13.7	12.0	3.8	4.0
6	6.0	3.8	5.0	5.8	5.0	9.5	2.7	2.1	12.4	15.0	3.65	3.65
7	5.2	3.3	4.3	4.2	6.5	5.6	2.6	2.0	9.7	16.0	3.7	3.3
8	4.2	3.1	4.2	3.6	7.7	4.0	2.5	2.0	7.4	16.3	3.65	3.15
9	3.5	3.0	3.9	3.3	6.1	6.7	2.4	1.9	5.0	11.0	3.7	3.0
10	3.2	2.8	3.6	3.2	5.0	5.0	3.0	1.8	4.2	8.15	3.6	2.9
11	3.0	2.6	3.4	3.0	7.9	4.4	3.8	1.8	3.4	5.6	3.55	2.9
12	8.0	2.4	3.2	3.1	8.5	4.0	4.0	1.7	3.2	4.95	3.6	2.8
13	16.0	2.3	3.1	3.1	7.1	3.6	3.2	1.7	3.0	4.6	3.85	2.8
14	16.4	2.2	3.0	2.9	5.6	4.1	2.8	1.6	2.9	4.4	3.9	2.8
15	16.1	5.0	3.0	3.5	4.2	5.4	2.6	1.6	2.8	4.15	3.9	2.6
16	15.0	4.0	2.9	7.5	4.0	6.3	11.6	1.5	2.7	4.1	3.85	2.6
17	12.0	3.5	2.9	11.1	4.0	4.2	9.0	1.5	2.6	3.95	3.8	2.6
18	13.5	3.4	2.8	6.6	4.2	3.7	6.4	1.4	2.5	3.9	3.75	2.6
19	13.7	3.3	2.8	5.5	3.8	3.4	4.0	1.4	2.4	3.8	3.8	2.5
20	11.4	3.2	2.7	4.5	3.5	3.2	3.2	1.3	2.3	3.65	3.7	2.5
21	6.0	3.0	3.4	4.1	3.2	3.0	2.1	1.3	2.15	3.6	3.75	2.5
22	4.0	2.9	3.3	3.9	3.0	2.8	2.0	1.2	2.2	3.95	3.8	2.4
23	3.1	2.8	3.3	3.7	13.5	2.6	1.9	1.9	2.1	3.9	3.8	2.4
24	3.0	2.7	3.3	3.5	13.3	2.4	1.8	2.8	2.35	3.8	3.75	3.0
25	3.0	2.6	3.2	3.4	13.2	3.5	2.0	2.4	3.6	3.65	4.0	3.4

Daily gage height, in feet, of Cahokia Creek near Poag, Ill., for 1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	2.9	4.0	3.2	3.5	8.2	3.0	4.0	2.2	8.15	3.7	4.05	3.2
27	2.8	11.8	3.2	4.5	5.0	4.0	2.8	2.0	14.0	3.55	4.9	3.0
28	2.7	12.9	3.1	4.1	4.5	4.2	3.0	1.8	10.2	3.6	5.55	3.4
29	2.6	.....	3.1	3.7	4.0	3.2	2.8	1.6	5.95	3.5	6.9	6.8
30	2.5	.....	3.1	3.4	7.4	2.8	2.6	1.4	4.3	3.45	6.8	6.4
31	2.4	.....	3.0	.....	4.5	.....	2.5	1.3	.....	3.4	.....	6.0

NOTE.—Ice was probably present during portions of January, February, and December.

Daily discharge, in second-feet, of Cahokia Creek near Poag, Ill., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	25	21	3,290	33	44	75	23	23	167	56	46	164
2	41	21	1,580	31	460	50	21	21	41	44	47	118
3	53	67	1,060	38	1,170	47	56	21	21	34	53	73
4	67	113	488	41	692	1,020	35	19	1,210	128	61	50
5	113	75	212	196	173	1,260	31	17	1,370	1,000	59	40
6	167	59	113	155	113	562	29	17	1,080	1,740	54	30
7	123	44	79	75	204	143	27	15	592	2,630	56	20
8	75	38	75	53	323	67	25	15	289	2,960	54	10
9	50	35	63	44	173	221	23	13	113	811	56	10
10	41	31	53	41	113	113	35	11	75	377	53	10
11	35	27	47	35	347	83	59	11	47	143	52	10
12	359	23	41	38	420	67	67	9	41	110	53	9
13	2,630	21	38	38	259	53	41	9	35	93	61	9
14	3,070	19	35	33	143	71	31	7	33	83	63	9
15	2,740	113	35	50	75	133	27	7	31	73	63	8
16	1,740	67	33	299	67	188	925	5	29	71	61	8
17	1,000	50	33	830	67	75	488	5	27	65	59	8
18	1,330	47	31	212	75	56	196	4	25	63	58	8
19	1,370	44	31	138	59	47	67	4	23	59	59	7
20	887	41	29	88	50	41	41	3	21	54	56	7
21	167	35	47	71	41	35	17	3	18	53	58	7
22	67	33	44	63	35	31	15	2	19	65	59	6
23	38	31	44	56	1,330	27	13	13	17	63	59	6
24	35	29	44	50	1,280	23	11	31	22	59	58	15
25	35	27	41	47	1,260	50	15	23	53	54	67	30
26	33	67	41	50	383	35	67	19	377	56	69	41
27	31	963	41	88	113	67	31	15	1,440	52	108	35
28	29	1,190	38	71	88	75	35	11	675	53	140	47
29	27	.....	38	56	67	41	31	7	164	50	239	230
30	25	.....	38	47	289	31	27	4	79	48	230	196
31	23	.....	35	.....	88	.....	25	3	.....	47	.....	167

NOTE.—Daily discharge computed from a well-defined curve based on 1910 measurements. Discharge during January and February probably somewhat large, owing to presence of ice. From Dec. 4 to 25 the discharge estimated because of ice.

Monthly discharge of Cahokia Creek near Poag, Ill., for 1910.

[Drainage area, 259 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	3,070	23	530	2.05	2.36	C.
February	1,190	19	119	.459	.48	C.
March	3,290	29	252	.973	1.12	A.
April	830	31	102	.394	.44	A.
May	1,330	35	323	1.25	1.44	A.
June	1,260	23	160	.618	.69	A.
July	925	11	81.7	.316	.36	A.
August	31	2	11.8	.046	.05	B.
September	1,440	17	271	1.05	1.17	A.
October	2,960	34	361	1.39	1.60	A.
November	239	46	73.7	.284	.32	A.
December	230	6	44.8	.173	.20	C.
The year	3,290	2	195	.753	10.23	

KASKASKIA RIVER.

GENERAL FEATURES OF AREA DRAINED.

Kaskaskia River, also called the Okaw, lies wholly in the State of Illinois. The river rises in the center of Champaign County, flows southwestward, and empties into the Mississippi in Randolph County, near the city of Chester, Ill. It is about 190 miles long, not following the bends, but as it is very crooked its length by course is not far from 400 miles. The total drainage area is 5,840 square miles. It has few tributaries worthy of mention, the most important being Shoal and Silver creeks, which enter from the north at the lower part of the river.

The drainage basin is long and comparatively narrow, the average width being about 30 miles and the maximum width about 60 miles. The ground is low, level, or undulating, and in consequence the slope of the river is small. The sources of the river are about 740 feet, and its mouth is about 350 feet, above sea level. The soil of the area is mostly black loam. In the lower portion of the drainage area the soil gradually changes to a yellowish brown clay. The only rock exposed along this stream is found about 20 miles above Shelbyville. In this 15 or 20 mile section the banks and bed are mostly soft soil with some gravel.

The basin contains no forested areas. The annual rainfall is about 40 inches. As a rule the winters are mild.

The question of storage has not been investigated to any extent. Opportunities for important water-power development are entirely lacking.

During wet weather the ground-water plane rises to the surface, and the rains run off into the streams very quickly, producing sudden rises and floods; in dry weather, as there is little or no ground water stored, the flow of the stream becomes very small and in some places dries up entirely. The banks of the river are low, and in times of floods large areas are covered with water, delaying the planting of crops and at times destroying growing crops. Storage, land drainage, and flood control are subjects of considerable importance in this basin.

KASKASKIA RIVER NEAR ARCOLA, ILL.

This station, which is located at the highway bridge known as the Bagdad Bridge, about 4 miles west of Arcola, Ill., and about 2¼ miles downstream from the Vandalia Railroad bridge, was established April 11, 1908, for the purpose of obtaining data for use in studying drainage, flood protection, and storage problems.

Lake Fork enters from the west 3 or 4 miles above the gaging station.

The datum of the chain gage has remained unchanged since the gage was installed.

The relation between gage height and discharge is somewhat affected by ice during portions of December, January, and February.

The records are accurate and reliable.

The river at this point is said to go dry at times and was dry for about two months in 1908. The high water of May, 1908, reached a height of 17.3 feet on the gage.

Discharge measurements of Kaskaskia River near Arcola, Ill., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 7	M. E. McChristie	205	734	7.78	635
10	do	124	441	6.40	392
10	do	124	442	6.37	396
May 13	H. J. Jackson	205	686	7.82	619
25	do	228	1,230	10.29	1,380
27	do	220	1,020	9.43	965
28	do	210	778	8.28	678
Dec. 28	P. S. Monk	130	452	[a] 6.84	416

[a] River full of floating ice.

Daily gage height, in feet, of Kaskaskia River near Arcola, Ill., for 1910.

[Lawrence L. Pfeifer, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.5	9.7	3.8	.....	6.8	6.8	5.4	2.5	2.85	1.95	5.25
2	.....	6.4	9.4	3.8	4.65	6.1	5.5	4.6	2.45	3.1	2.6	5.15
3	5.7	6.2	8.9	.....	5.2	5.7	5.2	3.7	2.5	3.75	2.55	5.2
4	5.8	6.2	8.7	3.8	5.55	5.4	5.1	3.3	2.35	4.2	2.6	5.15
5	5.9	6.0	8.4	3.8	5.6	5.2	5.1	3.0	3.4	4.55	2.45	5.05
6	6.2	.....	.....	3.7	5.65	5.1	4.5	2.9	7.6	4.75	2.35	5.05
7	6.2	5.8	7.8	3.7	5.7	4.8	4.0	2.7	7.75	5.0	2.4	5.05
8	6.2	5.6	7.4	3.7	.....	4.5	3.8	2.6	7.4	4.95	2.35	5.0
9	.....	5.6	7.1	3.6	6.3	4.4	3.6	2.3	7.15	4.3	2.3	4.95
10	6.1	5.7	6.5	.....	6.45	4.3	3.4	2.3	7.0	3.55	2.25	4.85
11	7.1	5.4	6.1	3.5	7.1	4.2	3.3	2.2	6.8	3.45	2.25	4.75
12	7.9	5.4	6.0	3.5	7.55	4.0	3.2	2.2	5.95	3.3	2.2	4.75
13	8.2	.....	.....	3.4	8.0	3.8	3.6	2.05	5.7	3.15	2.15	4.8
14	8.4	4.8	5.7	3.4	8.2	3.7	3.6	2.1	5.35	2.9	2.15	4.65
15	8.8	4.8	5.7	3.4	.....	3.5	3.3	1.95	4.9	2.65	2.05	4.65
16	.....	4.8	5.6	3.6	6.0	3.4	4.6	3.3	4.6	2.65	2.05	4.55
17	9.8	4.9	5.4	.....	5.8	3.4	7.0	5.2	4.05	2.7	2.1	4.55
18	11.3	4.9	5.2	3.8	5.6	3.2	7.3	4.95	4.0	2.55	1.95	4.35
19	12.0	4.9	5.0	3.9	5.4	3.0	6.8	4.9	3.65	2.6	1.95	4.4
20	11.9	.....	.....	4.1	5.2	2.9	5.7	4.55	3.6	2.45	1.95	4.15
21	11.8	4.9	4.8	4.2	5.3	2.9	4.2	3.2	3.4	2.45	1.85	4.15
22	11.6	.....	4.8	4.1	.....	2.9	4.0	2.9	3.35	2.5	1.9	4.05
23	.....	4.9	4.7	4.0	7.0	2.8	3.9	2.85	3.2	2.45	1.85	3.95
24	9.4	4.9	4.6	.....	8.9	2.7	2.3	2.8	2.95	2.4	1.75	3.9
25	9.0	4.3	4.5	4.4	10.2	2.6	3.2	2.85	3.0	2.35	1.75	3.75
26	8.5	4.0	4.5	5.2	10.1	2.5	3.0	2.9	3.4	2.25	1.65	3.75
27	7.5	.....	.....	5.0	9.4	2.7	4.0	2.8	3.55	2.3	4.6	4.05
28	7.0	9.0	4.3	4.9	8.5	5.4	6.0	2.65	3.35	2.15	5.15	6.25
29	6.8	.....	4.1	4.8	7.8	7.6	6.2	2.7	3.2	2.2	5.35	6.7
30	.....	.....	4.0	4.5	7.3	7.8	8.0	2.55	2.95	2.15	5.25	7.1
31	6.5	.....	3.9	.....	7.1	.....	7.0	2.6	.....	2.05	.....	7.1

NOTE.—Ice present Jan. 1 to 10 and Dec. 20 to 27. Gage read to top of ice Jan. 6 and 7.

Daily discharge, in second-feet, of Kaskaskia River near Arcola, Ill., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	100	386	1,160	114	178	432	432	254	33	50	14	239
2	100	372	1,070	114	182	332	265	178	31	64	38	229
3	150	345	909	114	234	287	234	106	33	110	36	234
4	170	345	850	114	270	254	224	77	27	146	38	229
5	170	320	767	114	276	234	224	58	84	174	31	219
6	170	309	689	106	282	224	170	53	577	192	27	219
7	170	298	620	106	287	196	130	43	609	214	29	219
8	170	276	537	106	320	170	114	38	537	210	27	214
9	200	276	482	98	358	162	98	25	491	154	25	210
10	332	287	386	94	379	154	84	25	465	94	23	200
11	482	254	332	91	482	146	77	21	432	88	23	192
12	642	254	320	91	567	130	70	21	314	77	21	192
13	714	224	304	84	665	114	98	16	287	67	20	196
14	767	196	287	84	714	106	98	18	249	53	20	182
15	879	196	287	84	482	91	77	13	205	40	16	182
16	1,030	196	276	98	320	84	178	77	178	40	16	174
17	1,190	205	254	106	298	84	465	234	134	43	18	174
18	1,710	205	234	114	276	70	518	210	130	36	14	158
19	1,960	205	214	122	254	58	432	205	102	38	14	162
20	1,920	205	205	138	234	53	287	174	98	31	14	142
21	1,890	205	196	146	244	53	146	70	84	31	11	14
22	1,820	205	196	138	338	53	130	33	80	33	12	13
23	1,430	205	187	130	465	48	122	50	70	31	11	126
24	1,070	205	178	146	909	43	25	48	55	29	9	122
25	940	154	170	162	1,330	38	70	50	58	27	9	110
26	794	130	170	234	1,290	33	58	53	84	23	7	110
27	557	386	162	214	1,070	43	130	48	94	25	178	134
28	465	940	154	205	794	254	320	40	80	20	229	352
29	432	.....	138	196	620	577	345	43	70	21	249	416
30	408	.....	130	170	518	620	665	36	55	20	239	482
31	386	.....	122	.....	482	.....	465	38	.....	16	.....	482

NOTE.—Daily discharge computed from a rating table that is well defined, and based on measurements made 1908–1910. From Jan. 1 to 10 the discharges are estimated because of presence of ice. Discharge interpolated for days of missing gage heights.

Monthly discharge of Kaskaskia River near Arcola, Ill., for 1910.

[Drainage area, 390 square miles.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	1,960	.....	749	1.92	2.21	C.
February	940	130	278	.713	.74	B.
March	1,170	122	387	.992	1.14	A.
April	234	84	128	.328	.37	A.
May	1,330	178	488	1.25	1.44	A.
June	620	33	171	.438	.49	A.
July	665	25	218	.559	.64	A.
August	254	13	76.6	.196	.23	A.
September	609	27	192	.492	.55	A.
October	214	16	70.9	.182	.21	A.
November	249	7	47.3	.121	.14	A.
December	482	.....	212	.544	.63	D.
The year	1,960	7	252	.646	8.79	

KASKASKIA RIVER AT SHELBYVILLE, ILL.

This station, which is located at the highway bridge at the edge of Shelbyville, just above the Chicago & Eastern Illinois and Big Four railroad bridges and just below the pumping station of the City

Water Co. of Shelbyville, was established February 25, 1908, for the purpose of collecting data for use in studying drainage and flood-control problems.

No important tributaries enter the stream near Shelbyville.

The relation between gage height and discharge is likely to be affected by ice during portions of December, January, and February. Gage heights may be affected during high water by backwater caused by the lodging of drift at the two railroad bridges below the gaging station.

The datum has remained unchanged since the gage was installed.

The records are accurate and reliable.

Discharge measurements of Kaskaskia River at Shelbyville, Ill., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 14	M. E. McChristie	110	443	7.94	797
May 14	H. J. Jackson	123	770	10.47	1,760
30	do	141	866	11.27	2,060
July 25	do	105	267	6.50	306
Dec. 31[a]	P. S. Monk	115	507	8.48	952

[a] Not at regular section. River full of floating ice.

Daily gage height, in feet, of Kaskaskia River at Shelbyville, Ill., for 1910.

[Homer Pound, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.6	7.9	14.1	6.5	6.8	9.6	7.8	8.9	5.6	6.25	5.65	9.55
2	7.9	7.7	13.1	6.5	6.7	9.2	7.9	8.35	5.8	6.15	5.8	8.65
3	7.9	7.8	13.3	6.4	7.4	8.8	8.2	7.5	5.65	6.1	5.85	7.75
4	8.2	7.7	13.5	6.4	7.8	8.5	7.1	6.75	5.8	6.15	5.75	7.65
5	8.2	7.7	13.6	6.4	8.2	8.5	7.9	6.5	5.85	6.3	5.8	7.4
6	9.1	7.6	11.6	6.4	8.1	8.1	7.5	6.3	8.9	7.35	5.75	7.15
7	9.1	7.5	11.1	6.3	9.1	7.7	7.25	6.45	10.0	8.45	5.8	6.65
8	9.4	7.6	10.4	6.3	9.8	7.4	6.85	6.1	13.15	8.7	5.75	6.65
9	9.6	7.4	9.9	6.1	9.9	7.3	6.5	5.85	11.8	8.35	5.65	6.75
10	8.5	7.3	9.4	6.1	9.1	7.1	6.3	5.9	10.45	7.9	5.65	6.8
11	7.9	7.2	8.9	6.1	10.5	7.1	6.3	5.8	9.6	7.45	5.65	6.65
12	7.8	7.0	8.5	6.2	11.2	6.9	6.15	5.75	8.6	7.15	5.75	6.55
13	10.5	6.6	8.5	6.2	11.1	6.8	6.85	5.8	7.85	7.0	5.8	6.65
14	13.1	6.9	7.9	6.2	10.5	6.6	6.8	5.65	7.6	6.8	5.65	6.75
15	13.9	6.9	7.6	6.2	10.1	6.5	6.7	5.7	7.05	6.55	5.65	6.7
16	13.5	6.9	7.5	6.6	9.7	6.5	7.9	7.1	6.9	6.8	5.65	6.55
17	12.6	6.7	7.4	6.7	9.2	6.4	8.65	7.75	6.65	6.45	5.65	6.45
18	15.1	6.5	7.3	6.7	8.6	6.4	9.65	8.5	6.5	6.35	5.7	6.25
19	17.0	6.7	7.2	6.7	8.2	6.4	9.2	7.85	6.25	6.3	5.65	6.25
20	18.6	6.6	7.1	6.7	8.1	6.3	8.6	7.5	6.2	6.25	5.65	6.3
21	15.6	7.1	6.9	6.7	7.9	6.1	8.1	6.7	6.15	6.4	5.65	6.15
22	14.0	7.0	6.9	6.6	8.7	5.9	7.35	6.55	6.05	6.25	5.65	6.15
23	13.5	7.0	6.9	6.6	14.1	5.9	6.85	6.5	6.1	6.15	5.7	6.25
24	12.2	6.8	6.8	6.5	15.2	5.9	6.7	7.25	6.15	6.2	5.65	6.65
25	11.2	6.7	6.8	6.5	16.2	5.9	6.45	6.9	6.7	6.05	5.65	6.5
26	10.5	6.7	6.7	6.5	15.8	5.9	6.1	6.5	6.55	6.1	5.65	6.25
27	9.7	11.9	6.7	6.6	13.3	6.4	6.1	6.25	6.45	6.05	13.75	6.05
28	9.1	13.5	6.7	6.7	12.5	6.8	6.15	6.2	6.4	6.05	13.9	7.85
29	8.8	.....	6.6	6.9	12.2	7.1	6.4	5.85	6.35	6.0	11.65	9.75
30	8.5	.....	6.6	6.8	11.4	7.6	7.85	5.8	6.3	5.85	10.2	9.4
31	8.2	.....	6.5	.....	10.4	.....	8.8	5.65	.....	5.8	.....	8.95

NOTE.—Ice present from Jan. 3 to 21 and from Feb. 23 to 26. Gage heights for Jan. 18 to 20 read to top of ice.

Daily discharge, in second-feet, of Kaskaskia River at Shelbyville, Ill., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	250	774	3,700	290	392	1,450	738	1,150	58	208	66	1,420
2	250	702	3,160	290	358	1,270	774	937	90	176	90	1,050
3	300	738	3,260	256	596	1,110	882	630	66	160	100	720
4	300	702	3,380	256	738	994	494	375	90	176	82	684
5	300	702	3,430	256	882	994	774	290	100	224	90	596
6	300	666	2,400	256	846	846	630	224	1,150	579	82	511
7	300	630	2,150	224	1,230	702	545	273	1,630	975	90	341
8	300	666	1,810	224	1,540	596	409	160	3,180	1,070	82	341
9	350	596	1,580	160	1,580	562	290	100	2,500	937	66	375
10	400	562	1,360	160	1,230	494	224	109	1,840	774	66	392
11	500	528	1,150	160	1,860	494	224	90	1,450	613	66	341
12	738	460	994	192	2,200	426	176	82	1,030	511	82	307
13	1,860	324	994	192	2,150	392	409	90	756	460	90	341
14	3,160	426	774	192	1,860	324	392	66	666	392	66	375
15	3,600	426	666	192	1,680	290	358	73	777	307	66	358
16	3,380	426	630	324	1,490	290	774	494	426	392	66	307
17	2,900	358	596	358	1,270	256	1,050	720	341	273	66	273
18	4,260	290	562	358	1,030	256	1,470	994	290	240	73	208
19	5,330	358	528	358	882	256	1,270	756	208	224	66	208
20	6,360	324	494	358	846	224	1,030	630	192	208	66	224
21	4,540	494	426	358	774	160	846	358	176	256	66	176
22	3,650	460	426	324	1,070	109	579	307	145	208	66	176
23	3,380	460	426	324	3,700	109	409	290	160	176	73	208
24	2,700	392	392	290	4,310	109	358	545	176	192	66	341
25	2,200	358	392	290	4,870	109	273	426	358	145	66	290
26	1,860	358	358	290	4,650	109	160	290	307	160	66	208
27	1,490	2,550	358	324	3,260	256	160	208	273	145	3,510	145
28	1,230	3,380	358	358	2,850	392	176	192	256	145	2,600	756
29	1,110	.....	324	426	2,700	494	256	100	240	130	2,420	1,520
30	994	.....	324	392	2,300	666	756	90	224	100	1,720	1,360
31	882	.....	290	.....	1,810	.....	1,110	66	.....	90	.....	1,170

NOTE.—Daily discharge computed from a rating curve well defined and based on discharge measurements made 1908–1910. From Jan. 1 to 11 the discharges are estimated because of presence of ice.

Monthly discharge of Kaskaskia River at Shelbyville, Ill., for 1910.

[Drainage area, 1,030 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	6,360	.....	1,910	1.86	2.14	C.
February	3,380	290	682	.662	.69	B.
March	3,700	290	1,220	1.18	1.36	B.
April	426	160	281	.273	.30	A.
May	4,870	358	1,840	1.79	2.06	B.
June	1,450	109	491	.477	.53	A.
July	1,470	160	581	.564	.65	A.
August	1,150	66	359	.349	.40	A.
September	3,180	58	638	.619	.69	A.
October	1,070	90	343	.333	.38	A.
November	3,600	66	439	.426	.48	A.
December	1,520	145	507	.492	.57	C.
The year	6,360	58	778	.755	10.25	

KASKASKIA RIVER AT VANDALIA, ILL.

This station, which is located at the highway bridge at the east end of Main Street, Vandalia, Ill., was established February 26, 1908, to obtain data for use in studying drainage questions, flood protection, and levee construction.

No important tributaries enter the river near Vandalia.

The relation between gage height and discharge during a portion of December, January, and February is likely to be somewhat affected by ice.

The river for some miles above and below Vandalia is leveed along the left bank. It is claimed that these levees, by confining the floods, have caused floods of unusual height on the right side of the river, and a number of lawsuits have been instituted to recover damages to property on the right bank. During extreme floods these levees sometimes give way, thus reducing the flood flow; some of the water passes around the gaging section.

The datum has remained unchanged since the gage was installed.

The records are reliable and accurate.

Discharge measurements of Kaskaskia River at Vandalia, Ill., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 26	H. J. Jackson	119	762	4.78	533
May 29	....do	152	2,010	13.90	4,000
June 4	....do	126	1,130	8.05	1,570
Dec. 21	P. S. Monk	110	475	[a]3.40	260

[a] Ice present.

Daily gage height, in feet, of Kaskaskia River at Vandalia, Ill., for 1910.

[W. F. Radcliff, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.95	19.7	4.3	4.8	10.75	4.2	5.8	2.6	3.35	2.45	10.65
2	.....	6.85	19.3	4.25	5.25	9.1	5.55	6.35	2.85	3.35	2.4	9.1
3	.....	7.5	18.25	4.2	7.0	8.25	7.5	5.95	3.95	3.35	2.3	8.75
4	.....	7.35	17.35	4.1	11.1	8.15	8.65	5.0	4.6	3.1	2.15	8.65
5	.....	6.15	16.3	4.1	8.05	9.65	7.9	4.55	4.9	6.45	2.15	8.35
6	.....	6.3	14.95	4.0	7.05	8.7	7.35	4.3	4.95	13.7	2.15	7.85
7	.....	6.2	13.35	4.0	7.35	7.15	7.05	3.95	7.0	13.6	2.15	7.55
8	6.3	6.2	11.75	3.9	10.9	6.5	6.6	3.8	8.45	10.6	2.05	7.05
9	.....	6.1	10.05	3.9	11.45	6.1	5.4	3.4	9.6	8.9	2.05	6.7
10	.....	5.8	9.15	3.8	10.05	5.85	4.45	3.05	10.5	8.05	2.05	6.2
11	6.85	5.35	8.4	3.8	9.5	5.8	3.95	3.3	9.4	6.2	2.05	5.5
12	8.35	4.95	8.0	3.8	13.8	5.5	4.95	3.65	8.65	5.65	2.05	4.35
13	10.5	4.9	7.35	3.7	15.25	5.15	4.45	3.0	7.2	5.15	2.05	4.0
14	12.65	4.9	7.0	3.7	13.05	5.0	4.6	4.3	6.45	4.8	2.05	3.65
15	15.0	4.9	6.6	3.7	10.8	4.95	4.1	4.8	6.0	4.4	2.05	3.25
16	14.25	4.8	6.25	4.0	9.35	4.85	13.0	5.15	5.35	4.25	2.05	3.2
17	13.0	4.8	6.05	5.9	8.8	4.65	16.4	5.15	4.55	4.05	2.05	3.1
18	13.45	4.8	5.85	7.0	8.15	4.4	16.9	5.25	4.15	3.85	2.05	3.05
19	17.1	4.8	5.65	7.05	7.55	4.1	13.75	7.15	3.95	3.75	2.05	3.1
20	17.5	4.8	5.45	6.25	7.05	4.2	9.35	7.8	3.6	3.7	2.05	3.0
21	16.65	5.75	5.35	5.45	7.15	4.3	7.6	5.6	3.15	3.5	2.05	3.1
22	16.3	5.55	5.25	4.8	12.8	4.4	6.75	8.2	2.85	3.4	2.05	3.1
23	16.2	5.35	5.1	4.6	15.05	4.5	5.85	6.0	3.3	3.25	2.0	3.1
24	14.55	5.25	5.0	4.5	16.95	4.6	5.2	4.2	3.5	3.15	2.1	2.9
25	13.45	5.15	4.95	4.45	18.55	3.4	4.85	4.3	4.15	3.15	2.0	2.9
26	11.5	5.5	4.8	6.5	18.3	3.95	4.35	4.55	4.25	3.15	2.1	2.8
27	9.9	15.8	4.7	5.75	17.25	6.0	4.15	4.25	4.5	3.15	2.0	2.95
28	8.8	18.2	4.6	5.2	16.05	4.75	3.95	3.7	4.2	3.05	4.45	3.4
29	8.1	.....	4.55	4.95	14.15	4.05	3.5	3.3	4.0	2.85	12.15	5.0
30	7.75	.....	4.5	4.85	14.8	5.0	3.15	3.2	3.5	2.75	11.7	6.45
31	7.3	.....	4.4	.....	13.8	.....	4.5	3.0	.....	2.65	.....	6.85

NOTE.—Ice present from Jan. 1 to 22 and also for a few days during the middle of February.

Daily discharge, in second-feet, of Kaskaskia River at Vandalia, Ill., for 1910

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	400	1,180	6,970	455	575	2,670	431	844	122	246	104	2,630
2	500	1,150	6,770	443	692	1,990	774	999	156	246	99	1,990
3	600	1,370	6,240	431	1,200	1,660	1,370	886	374	246	88	1,850
4	700	1,320	5,800	408	2,820	1,620	1,810	625	527	198	73	1,810
5	800	942	5,270	408	1,580	2,210	1,520	515	600	1,030	73	1,690
6	900	984	4,610	385	1,220	1,830	1,320	455	612	4,010	73	1,500
7	940	956	3,850	385	1,320	1,250	1,220	374	1,200	3,970	73	1,390
8	984	956	3,120	362	2,740	1,040	1,070	340	1,730	2,600	64	1,220
9	1,040	928	2,370	362	2,980	928	732	256	2,190	1,910	64	1,100
10	1,090	844	2,010	340	2,800	858	491	189	2,560	1,580	64	956
11	1,150	718	1,710	340	2,150	844	374	236	2,110	956	64	760
12	1,690	612	1,560	340	4,060	760	612	307	1,810	802	64	467
13	2,560	600	1,320	318	4,750	664	491	180	1,270	664	64	385
14	3,530	600	1,200	318	3,710	625	527	455	1,030	575	64	307
15	4,630	600	1,070	318	2,690	612	408	575	900	479	64	226
16	4,270	575	970	385	2,090	588	3,690	664	718	443	64	216
17	3,690	575	914	872	1,870	539	5,320	664	515	396	64	198
18	3,900	575	858	1,200	1,620	479	5,570	692	420	351	64	189
19	5,670	575	802	1,220	1,390	408	4,040	1,250	374	329	64	198
20	5,870	575	746	970	1,220	431	2,090	1,480	296	318	64	180
21	5,440	830	718	746	1,250	455	1,410	788	207	276	64	198
22	5,270	774	692	575	3,600	479	1,120	1,640	156	256	64	198
23	5,220	718	651	527	4,650	503	858	900	236	226	59	198
24	4,410	692	625	503	5,600	527	678	431	276	207	68	164
25	3,900	664	612	491	6,400	256	580	455	420	207	59	164
26	3,000	760	575	1,040	6,270	374	467	515	443	207	68	149
27	2,310	5,020	551	830	5,740	900	420	443	503	207	59	172
28	1,870	6,220	527	678	5,140	563	374	318	431	189	491	256
29	1,600	.....	515	612	4,220	396	276	236	385	156	3,300	625
30	1,460	.....	503	588	4,530	625	207	216	276	142	3,090	1,030
31	1,300	.....	479	.....	4,060	.....	503	180	.....	128	.....	1,150

NOTE.—Daily discharge computed from a rating curve well-defined between 88 and 4,150 second-feet, and based on measurements of 1908 to 1910. Discharge estimated from Jan. 1 to 10 because of presence of ice.

Monthly discharge of Kaskaskia River at Vandalia, Ill., for 1910.

[Drainage area, 1,980 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	5,870	.....	2,600	1.31	1.51	C.
February	6,220	575	1,150	.581	.60	A.
March	6,970	479	2,080	1.05	1.21	B.
April	1,220	318	562	.284	.32	A.
May	6,400	575	3,060	1.55	1.79	A.
June	2,670	256	903	.456	.51	A.
July	5,570	207	1,320	.667	.77	A.
August	1,640	180	584	.295	.34	A.
September	2,560	122	762	.385	.43	A.
October	4,010	128	760	.384	.44	A.
November	3,300	59	291	.147	.16	B.
December	2,630	.....	760	.384	.44	C.
The year	6,970	59	1,240	.626	8.52	

KASKASKIA RIVER AT CARLYLE, ILL.

This station, which is located at the Baltimore & Ohio Southwestern Railroad bridge about one-fourth mile east of the railroad station at Carlyle, Ill., was established March 2, 1908, for the purpose

of obtaining data for use in studying drainage, flood control, and water supply problems.

The river receives no important tributaries for 10 miles above and below this station. Shoal Creek comes in on the right bank about 15 miles below the station.

The intake of the water-supply system of Carlyle is above the gaging station. The dam is about 700 feet above the section and is about 3½ feet high. The average amount of water pumped is about 3,500,000 gallons every 30 days, and during June, July, and August the quantity is about 4,500,000 gallons every 30 days. The outfalls of one section of the city sewerage system and some private sewers are above the gaging station, so the diversion is small.

The datum has remained unchanged since the gage was installed. The records are accurate and reliable.

The flood of 1882, which is the highest known, is said to have reached a height of 1½ feet higher than the flood of 1908, or about 32½ feet on the present gage. The stream never goes dry at this point. It has been noticed during periods of low water that the water is hard, a fact that indicates that the flow is maintained by springs.

Discharge measurements of Kaskaskia River at Carlyle, Ill., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 25	H. J. Jackson	139	531	9.24	818
May 20	C. T. Bailey	158	1,020	12.70	1,840
27	do	522	3,510	20.52	4,710
29	do	526	3,910	21.17	5,310
June 2	do	526	4,040	21.76	6,150
6	do	198	2,150	18.92	3,890
7	do	198	1,900	17.66	3,310
8	do	166	1,160	13.63	1,940
July 30	H. J. Jackson	132	356	8.05	561
Dec. 7	Bailey and Monk	139	550	9.62	846
20	P. S. Monk	128	293	7.64	440

Daily gage height, in feet, of Kaskaskia River at Carlyle, Ill., for 1910.

[Arnold J. Marcham, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	9.6	13.7	22.1	8.3	9.2	21.8	8.7	8.8	7.0	8.2	6.9	13.25
2	10.0	12.5	23.8	8.2	8.9	21.7	8.4	9.3	6.9	7.8	6.85	14.5
3	10.3	12.0	24.8	8.1	8.7	21.5	8.6	9.8	6.7	7.5	6.8	14.05
4	10.7	12.7	24.5	8.0	10.0	20.6	9.8	10.0	7.6	7.35	6.65	12.8
5	11.4	13.7	24.1	8.1	11.3	19.7	11.9	10.2	9.1	7.7	6.65	11.45
6	11.6	12.8	23.6	8.2	12.4	18.9	14.1	9.6	9.9	15.9	6.55	10.1
7	12.3	11.9	23.0	8.3	12.2	17.0	13.2	8.9	11.0	19.25	6.7	9.5
8	12.4	11.2	22.6	8.3	13.5	13.9	12.3	8.2	13.4	20.3	6.75	9.0
9	10.5	10.7	22.2	8.1	15.0	12.4	11.0	7.8	15.2	20.95	6.8	8.8
10	11.5	10.5	17.3	7.9	16.3	11.3	10.5	7.6	15.9	21.5	6.8	8.6
11	11.0	10.3	16.1	7.8	16.0	10.7	9.6	7.4	15.8	21.7	6.65	8.4
12	10.9	10.0	14.8	7.7	15.0	10.2	9.2	7.2	15.1	19.9	6.65	8.2
13	16.0	9.8	13.2	7.6	17.1	9.8	8.7	7.1	14.0	17.7	6.55	8.0
14	19.4	9.6	13.0	7.5	18.2	9.4	8.4	6.95	13.1	12.9	6.5	7.8
15	20.4	9.4	12.2	7.5	18.4	9.2	8.2	6.8	11.9	10.9	6.5	7.7

Daily gage height, in feet, of Kaskaskia River at Carlyle, Ill, for 1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	21.0	9.5	11.5	8.7	18.6	9.0	10.3	6.7	10.8	10.5	6.4	7.6
17	21.5	9.9	11.0	10.1	17.1	8.8	14.6	7.2	9.7	10.15	6.4	7.5
18	21.6	10.4	10.6	11.4	15.7	8.6	18.4	7.9	8.5	9.9	6.3	7.45
19	21.8	11.1	10.3	11.2	13.5	8.4	19.2	9.0	8.3	9.4	6.25	7.4
20	21.9	10.5	10.1	10.7	12.6	8.2	19.6	9.7	8.1	8.85	6.3	7.45
21	22.0	10.2	10.0	9.8	11.8	8.0	19.9	10.4	7.9	8.4	6.2	7.3
22	22.1	10.6	9.7	9.3	13.7	7.9	19.1	11.2	7.8	7.85	6.25	7.2
23	22.0	11.8	9.6	8.9	18.0	7.8	17.9	11.6	7.7	7.8	6.15	7.1
24	21.9	13.5	9.5	8.7	19.0	7.75	14.6	12.3	7.6	7.7	6.15	7.05
25	21.8	13.6	9.25	8.5	19.6	7.5	12.2	9.9	7.5	7.55	6.15	7.0
26	21.6	12.2	9.2	8.4	20.2	7.4	10.3	8.5	7.4	7.5	6.1	6.95
27	21.5	16.1	9.05	8.5	20.6	7.8	9.4	8.3	8.0	7.35	7.0	6.9
28	21.4	20.9	8.9	9.2	20.9	8.4	8.8	8.2	8.6	7.3	7.25	7.1
29	20.9	.....	8.7	9.9	21.3	10.8	8.3	8.1	9.2	7.2	8.05	7.4
30	17.8	.....	8.6	9.6	21.6	9.6	8.1	7.7	8.4	7.05	11.2	7.9
31	15.7	.....	8.4	.....	21.9	.....	8.4	7.4	.....	7.0	.....	9.5

NOTE.—Ice present from Jan. 1 to 4.

Daily discharge, in second-feet, of Kaskaskia River at Carlyle, Ill., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	926	2,060	6,720	590	822	6,270	692	718	280	565	260	1,920
2	1,030	1,710	9,310	565	744	6,110	615	848	260	466	250	2,300
3	1,110	1,570	10,800	540	692	5,810	666	978	220	394	240	2,160
4	1,220	1,770	10,400	515	1,030	4,660	978	1,030	418	358	211	1,790
5	1,410	2,060	9,760	540	1,380	4,110	1,540	1,080	796	442	211	1,420
6	1,460	1,790	9,000	565	1,680	3,760	2,180	926	1,000	2,730	193	1,060
7	1,650	1,540	8,090	590	1,630	3,080	1,910	744	1,300	3,900	220	900
8	1,680	1,350	7,480	590	2,000	2,120	1,650	565	1,970	4,450	230	770
9	1,160	1,220	6,870	540	2,450	1,680	1,300	466	2,510	5,030	240	718
10	1,440	1,160	3,180	490	2,860	1,380	1,160	418	2,730	5,810	240	666
11	1,300	1,110	2,790	466	2,760	1,220	926	370	2,700	6,110	211	615
12	1,270	1,030	2,390	442	2,450	1,080	822	324	2,480	4,220	211	565
13	2,760	978	1,910	418	3,110	978	692	302	2,140	3,320	193	515
14	3,970	926	1,850	394	3,500	874	615	270	1,880	1,820	184	466
15	4,510	874	1,630	394	3,570	822	565	240	1,540	1,270	184	442
16	5,090	900	1,440	692	3,650	770	1,110	220	1,250	1,160	166	418
17	5,810	1,000	1,300	1,060	3,110	718	2,330	324	952	1,070	166	394
18	5,960	1,140	1,190	1,410	2,670	666	3,570	490	640	1,000	148	382
19	6,270	1,330	1,110	1,350	2,000	615	3,880	770	590	874	140	370
20	6,420	1,160	1,060	1,220	1,740	565	4,060	952	540	731	148	382
21	6,570	1,080	1,030	978	1,520	515	4,220	1,140	490	615	132	346
22	6,720	1,190	952	848	2,060	490	3,840	1,350	466	478	140	324
23	6,570	1,520	926	744	3,430	466	3,390	1,460	442	466	124	302
24	6,420	2,000	900	692	3,800	454	2,330	1,650	418	442	124	291
25	6,270	2,020	835	640	4,060	394	1,630	1,000	394	406	124	280
26	5,960	1,630	822	615	4,380	370	1,110	640	370	394	116	270
27	5,810	2,790	783	640	4,660	466	874	590	515	358	280	260
28	5,660	4,970	744	822	4,970	615	718	565	666	346	335	302
29	4,970	.....	692	1,000	5,510	1,250	590	540	822	324	528	370
30	3,360	.....	666	926	5,960	926	540	442	615	291	1,350	490
31	2,670	.....	615	.....	6,420	.....	615	370	.....	280	.....	900

NOTE.—Daily discharge computed from a well-defined rating curve based on measurements made 1908–1910.

Monthly discharge of Kaskaskia River at Carlyle, Ill., for 1910.

[Drainage area, 2,680 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	6,720	926	3,790	1.41	1.63	B.
February	4,970	874	1,570	.586	.61	A.
March	10,800	615	3,460	1.29	1.49	A.
April	1,410	394	709	.265	.30	A.
May	6,420	692	2,920	1.09	1.26	A.
June	6,270	370	1,770	.660	.74	A.
July	4,220	540	1,650	.616	.71	A.
August	1,650	220	703	.262	.30	A.
September	2,730	220	1,050	.392	.44	A.
October	6,110	280	1,620	.604	.70	A.
November	1,350	116	243	.091	.10	A.
December	2,300	260	722	.269	.31	A.
The year	10,800	116	1,690	.631	8.59	

KASKASKIA RIVER AT NEW ATHENS, ILL.

This station, which is located at the Illinois Central Railroad bridge, about 600 feet north of the Illinois Central Railroad station at New Athens, Ill., and about 600 feet upstream from the highway bridge, was established November 1, 1909, for the purpose of obtaining data for use in studying problems of drainage, flood control, and navigation.

Silver Creek enters on the right bank about 1 mile above and Lively Creek on the left bank about 3 miles below the gaging station.

The datum of the gage has remained unchanged since the gage was installed. The records are accurate and reliable. The stream is fed by springs and never goes dry at this point. The relation between gage height and discharge is liable to be affected by ice in December, January, and February. The flood of the fall of 1898 reached a height of about 34.5 feet on the present gage datum.

A record of river height at this point from January 23, 1907, to October 28, 1909, inclusive, was kept for the New Athens Journal by C. J. von Roth Roffy. The river height was taken on Wednesday and Thursday mornings of each week, the river height for Thursday being published each Friday with the change in twenty-four hours, as obtained from the river height of Wednesday. This record of stage was kept by the Journal mainly for the information of farmers who lived on the west side of the river and who are cut off from reaching New Athens via the highway bridge when the river reaches a stage of about 30 feet. The record is authentic. These gage heights have been carefully reduced to the datum of the present gage. The maximum error is probably not over 0.4 foot; the lower the stage the greater the error.

Discharge measurements of Kaskaskia River near New Athens, Ill., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 23	H. B. Jackson	205	1,220	7.48	1,400
May 21	C. T. Bailey	216	1,780	9.96	2,820
21[a]	....do	202	2,030	9.72	2,440
22	....do	213	1,580	9.18	2,260
26	....do	271	4,250	20.55	11,700
30	....do	271	4,420	21.06	11,800
31	....do	261	4,210	20.28	10,300
June 1	....do	260	4,090	19.77	9,570
5	....do	248	3,520	17.63	7,930
7	....do	251	3,760	18.32	8,650
Dec. 10	Bailey and Monk	195	945	5.96	902

[a] Measurement made at highway bridge.

Daily gage height, in feet, of Kaskaskia River at New Athens, Ill., for 1910.

[C. J. von Roth Roffy, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.6	16.9	21.85	6.2	7.8	19.95	8.0	5.9	6.1	7.9	4.9	4.9
2	8.45	14.35	22.9	6.05	7.2	19.35	7.0	5.5	5.5	6.4	4.75	9.5
3	9.0	11.6	24.2	6.2	8.7	18.7	7.45	5.3	5.45	5.85	4.7	10.75
4	9.0	10.5	24.7	6.1	9.05	18.0	7.9	5.6	7.0	6.25	4.65	10.5
5	9.1	10.8	25.0	6.55	10.1	17.55	8.35	6.5	17.45	10.5	4.55	9.25
6	10.15	11.9	25.25	7.15	10.95	17.95	10.45	6.65	20.75	18.7	4.5	8.2
7	11.15	11.7	25.15	7.15	13.6	18.25	12.25	6.7	22.8	20.4	4.45	7.3
8	11.6	10.65	24.7	7.6	12.9	18.4	12.65	6.4	23.8	21.35	4.4	6.85
9	11.5	9.55	23.95	7.3	12.65	17.9	11.05	6.0	23.85	21.85	4.4	6.45
10	10.7	8.85	23.1	6.65	13.8	15.3	9.6	5.4	23.65	22.55	4.3	5.9
11	9.7	8.45	22.4	6.3	14.5	12.9	8.4	5.1	23.25	22.9	4.3	5.85
12	8.9	8.2	21.75	6.1	14.45	11.3	9.3	4.9	22.85	23.0	4.2	5.65
13	14.4	7.9	21.1	5.85	13.7	10.65	10.55	4.65	22.15	23.0	4.25	5.55
14	18.9	7.75	20.35	5.6	13.8	10.0	9.0	4.45	21.05	22.55	4.2	5.45
15	20.1	7.85	17.5	6.8	14.9	9.0	7.5	4.3	18.2	21.85	4.1	5.0
16	20.8	8.3	14.5	7.55	14.9	7.95	11.7	4.2	12.55	19.9	4.15	5.0
17	21.65	8.75	10.8	11.65	14.25	7.45	14.65	4.1	9.4	14.4	4.05	4.85
18	22.1	8.4	9.45	13.85	13.75	7.8	15.7	4.1	8.1	9.3	4.05	4.7
19	22.45	8.8	8.85	14.95	12.7	7.4	16.35	4.0	7.25	7.7	4.05	4.65
20	22.65	8.65	8.35	14.85	11.2	6.65	17.1	4.5	6.7	7.05	3.95	4.7
21	22.65	8.7	8.05	12.85	10.1	6.1	17.15	5.8	6.25	6.65	4.0	4.9
22	22.55	8.95	7.75	10.05	9.3	7.6	16.7	7.35	5.9	6.35	3.9	4.4
23	22.45	9.1	7.5	8.45	13.9	7.95	15.7	12.65	5.65	6.1	3.95	4.4
24	22.3	10.0	7.3	7.65	18.65	6.75	14.4	17.45	5.45	5.95	3.95	4.5
25	21.8	11.0	7.4	7.15	19.75	6.0	12.1	18.35	5.55	5.8	3.85	4.65
26	21.2	11.4	7.75	6.8	20.5	5.65	9.55	19.15	6.45	5.65	3.9	4.35
27	20.5	17.9	7.8	6.8	21.4	5.55	8.9	19.15	6.3	5.5	3.85	4.3
28	19.8	.....	7.7	6.8	21.5	6.6	8.75	17.95	6.4	5.25	3.85	4.3
29	19.1	.....	7.25	6.9	21.4	7.3	7.65	14.95	10.0	5.2	3.85	4.5
30	18.5	.....	6.75	7.55	21.15	7.95	7.5	11.25	10.15	5.1	3.8	4.75
31	17.6	.....	6.4	.....	20.5	.....	6.65	7.4	.....	4.95	.....	5.2

NOTE.—Ice present from Jan. 1 to 3.

Daily discharge, in second-feet, of Kaskaskia River at New Athens, Ill., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,510	7,180	15,300	938	1,610	10,300	1,700	836	904	1,650	560	560
2	1,920	5,260	18,900	887	1,340	9,520	1,250	710	710	1,010	527	2,480
3	2,200	3,630	23,400	938	2,050	8,810	1,450	656	696	819	516	3,160
4	2,200	3,020	25,100	904	2,230	8,130	1,650	738	1,250	956	505	3,020
5	2,250	3,190	26,200	1,070	2,800	7,730	1,880	1,050	7,640	3,020	484	2,340
6	2,830	3,800	27,000	1,310	3,270	8,080	3,000	1,110	11,700	8,810	474	1,800
7	3,380	3,680	26,700	1,310	4,790	8,360	3,990	1,130	18,600	11,000	464	1,380
8	3,630	3,110	25,100	1,510	4,370	8,510	4,220	1,010	22,000	13,600	454	1,190
9	3,580	2,500	22,500	1,380	4,220	8,040	3,330	870	22,200	15,300	454	1,030
10	3,140	2,120	19,600	1,110	4,910	5,930	2,530	682	21,500	17,700	434	836

Daily discharge, in second-feet, of Kaskaskia River at New Athens, Ill., for 1910—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	2,580	1,920	17,200	974	5,370	4,370	1,900	606	20,100	18,900	434	819
12	2,150	1,800	14,900	904	5,340	3,460	2,360	560	18,700	19,200	414	754
13	5,300	1,650	12,700	819	4,850	3,110	3,050	505	16,300	19,200	424	724
14	9,010	1,580	10,900	738	4,910	2,750	2,200	464	12,500	17,700	414	696
15	10,500	1,630	7,680	1,170	5,650	2,200	1,470	434	8,310	15,300	396	582
16	11,800	1,850	5,370	1,490	5,650	1,680	3,680	414	4,160	10,200	405	582
17	14,600	2,080	3,190	3,660	5,200	1,450	5,480	396	2,420	5,300	387	549
18	16,100	1,900	2,450	4,940	4,880	1,610	6,230	396	1,750	2,360	387	516
19	17,400	2,100	2,120	5,680	4,250	1,420	6,740	378	1,360	1,560	387	505
20	18,000	2,020	1,880	5,620	3,410	1,110	7,340	474	1,130	1,270	369	516
21	18,000	2,050	1,720	4,340	2,800	904	7,390	802	956	1,110	378	560
22	17,700	2,180	1,580	2,780	2,360	1,510	7,020	1,400	836	992	360	454
23	17,400	2,260	1,470	1,920	4,970	1,680	6,230	4,220	754	904	369	454
24	16,800	2,750	1,380	1,540	8,760	1,150	5,300	7,640	696	853	369	474
25	15,100	3,300	1,420	1,310	10,000	870	3,900	8,460	724	802	352	505
26	13,000	3,520	1,580	1,170	11,100	754	2,500	9,280	1,030	754	360	444
27	11,100	8,040	1,600	1,170	13,700	724	2,150	9,280	974	710	352	434
28	10,100	10,200	1,560	1,170	14,100	1,090	2,080	8,080	1,010	643	352	434
29	9,230	.....	1,360	1,210	13,700	1,380	1,540	5,680	2,750	630	352	474
30	8,610	.....	1,150	1,490	12,900	1,680	1,470	3,440	2,830	606	344	527
31	7,770	.....	1,010	.....	11,100	.....	1,110	1,420	.....	571	.....	630

NOTE.—Daily discharge computed from a rating curve well defined between 378 and 15,800 second-feet.

Monthly discharge of Kaskaskia River at New Athens, Ill., for 1910.

[Drainage area, 5,220 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile		
January	18,000	1,510	9,000	1.72	1.98	B.
February	10,200	1,580	3,230	.619	.64	A.
March	27,000	1,010	10,500	2.01	2.32	A.
April	5,680	738	1,850	.354	.40	A.
May	14,100	1,340	6,020	1.15	1.33	A.
June	10,300	724	3,940	.755	.84	A.
July	7,390	1,110	3,420	.655	.76	A.
August	9,280	378	2,360	.452	.52	A.
September	22,200	696	6,880	1.32	1.47	A.
October	19,200	571	6,240	1.19	1.37	A.
November	560	344	416	.080	.09	A.
December	3,160	434	949	.182	.21	A.
The year	27,000	344	4,590	.879	11.93	

SHOAL CREEK NEAR BREESE, ILL.

Shoal Creek is tributary to Kaskaskia River in Clinton County about 15 miles below Carlyle.

The gaging station, which is located at the Baltimore & Ohio Southwestern Railroad bridge about 1½ miles east of Breese, Ill., was established November 5, 1909, for the purpose of obtaining data for use in studying problems of drainage, flood control, water supply, and storage.

Beaver Creek enters on the left bank about 3 miles below the gaging section. The intake of the pumping station of the water-supply system of Breese is about one-fourth mile above the gaging section.

The relation between gage height and discharge is apt to be affected by ice during December, January, and February.

The datum of the gage has remained unchanged since the gage was installed. The records are accurate and reliable.

The creek is fed by springs and has not been known to go dry at this point. The flood of 1907 reached a height representing about 22 feet on the present gage.

Discharge measurements of Shoal Creek near Breese, Ill., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 25	H. J. Jackson	60	63	1.80	116
May 19	C. T. Bailey	66	98	2.40	270
26[a]	do	586	2,440	17.36	4,080
28[b]	do	136	1,440	17.12	3,470
31	do	90	863	11.85	1,940
June 2	do	74	195	3.95	387
3	do	70	143	3.24	278
July 29	H. J. Jackson	60	56	1.72	98
Dec. 7[c]	Bailey and Monk	57	38.4	1.50	42.4

[a] Partly estimated. [b] No flow in flood channel. [c] Slight amount of ice present.

Daily gage height, in feet, of Shoal Creek near Breese, Ill., for 1910.

[John Nordman, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.7	17.6	1.7	2.2	6.2	1.9	1.6	1.8	2.4	1.7	1.9
2	3.4	2.3	18.9	1.7	2.15	5.1	1.85	1.4	1.85	2.1	1.6	1.7
3	3.9	2.2	19.0	1.7	7.8	3.0	2.1	1.5	1.8	1.85	1.65	1.55
4	4.2	5.15	18.1	1.65	13.3	5.2	1.9	1.55	13.3	2.7	1.65	1.6
5	5.0	4.9	16.6	1.65	12.1	13.7	4.9	1.5	14.7	5.4	1.6	1.55
6	6.7	3.8	11.4	3.1	10.4	14.5	7.65	1.5	15.75	16.3	1.65	1.55
7	8.4	2.9	7.5	5.15	7.2	7.4	6.8	1.5	16.8	16.95	1.6	1.45
8	6.6	2.6	5.3	2.8	8.0	4.5	3.7	1.5	16.95	18.2	1.65	1.5
9	5.4	2.3	4.0	2.3	10.6	3.7	2.0	1.55	15.8	18.85	1.65	1.5
10	3.85	2.2	3.6	2.1	7.2	4.0	2.1	1.5	12.2	18.0	1.6	1.5
11	3.4	2.15	2.9	1.8	5.1	3.2	2.8	1.5	8.1	10.4	1.6	1.5
12	3.2	2.1	2.55	1.8	4.2	2.6	2.0	1.5	3.3	7.0	1.55	1.45
13	14.4	2.05	2.3	1.8	8.1	2.3	2.1	1.5	2.3	4.2	1.6	1.45
14	16.0	2.0	2.25	1.85	12.4	2.0	2.2	1.5	2.2	3.8	1.6	1.45
15	16.9	2.25	2.15	2.6	7.2	3.2	1.9	1.45	2.15	3.5	1.55	1.4
16	17.1	2.8	2.1	8.2	5.2	5.3	9.9	1.45	2.1	3.2	1.6	1.4
17	17.9	3.7	2.05	13.4	2.9	6.4	13.5	1.5	1.9	2.1	1.55	1.4
18	17.3	3.2	2.0	14.8	2.6	2.3	15.95	2.1	1.85	2.0	1.6	1.4
19	16.6	2.4	2.0	13.55	2.45	2.15	16.2	3.2	1.8	1.95	1.6	1.4
20	16.65	2.2	1.95	7.15	2.25	7.7	11.3	5.1	1.7	1.9	1.55	1.4
21	16.3	2.4	1.9	4.2	2.1	9.0	5.8	3.8	1.7	1.9	1.6	1.4
22	12.2	2.7	1.95	3.1	3.2	4.7	3.4	5.4	1.75	1.9	1.55	1.4
23	7.1	3.8	1.95	2.6	14.0	2.1	3.2	11.2	1.75	1.9	1.6	1.4
24	5.2	3.7	1.9	2.3	15.8	1.9	3.1	16.5	2.1	1.9	1.6	1.4
25	3.9	2.85	1.9	2.4	16.3	1.8	2.0	16.9	4.2	1.85	1.55	1.4
26	3.5	3.2	1.85	2.35	17.1	1.85	1.9	15.6	9.4	1.85	1.6	1.4
27	3.7	7.8	1.85	2.5	17.85	2.9	1.75	7.9	12.6	1.8	1.55	1.4
28	4.1	16.4	1.8	2.7	17.5	6.1	1.4	4.1	12.0	1.8	1.65	1.55
29	3.9	.....	1.8	2.5	10.5	3.2	1.7	2.8	4.5	1.75	2.8	2.0
30	3.7	.....	1.75	2.25	8.2	2.0	1.65	2.1	2.5	1.7	2.05	5.1
31	3.0	.....	1.75	.....	12.5	.....	1.6	1.9	.....	1.65	.....	4.7

NOTE.—Ice present Jan. 1 to 18 and Feb 17 to 26. Gage readings from Jan. 10 to 17 are to the top of ice.

Daily discharge, in second-feet, of Shoal Creek near Breese, Ill., for 1910.

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	70	197	4,290	90	137	786	106	84	98	161	90	106
2	70	149	5,970	90	132	588	102	72	102	126	84	90
3	70	137	6,100	90	1,070	235	126	78	98	102	87	80
4	70	597	4,930	87	2,190	606	106	81	2,190	197	87	70
5	70	553	3,160	87	1,920	2,270	553	78	2,500	642	84	60
6	60	366	1,780	251	1,580	2,450	1,050	78	2,790	3,000	87	50
7	60	222	1,020	597	966	1,000	894	78	3,340	3,510	84	42
8	60	185	624	209	1,110	485	349	78	3,510	5,060	87	42
9	70	149	400	149	1,620	349	115	81	2,810	5,900	87	42
10	70	137	332	126	966	400	126	78	1,940	4,800	84	42
11	70	132	222	98	588	267	209	78	1,130	1,580	84	42
12	100	126	179	98	434	185	115	78	283	930	81	42
13	2,430	120	149	98	1,130	149	126	78	149	434	84	42
14	2,880	115	143	102	1,990	115	137	78	137	366	84	42
15	3,450	143	132	185	966	267	106	75	132	315	81	40
16	3,690	209	126	1,150	606	624	1,480	75	126	267	84	40
17	4,670	349	120	2,210	222	822	2,230	78	106	126	81	40
18	3,930	267	115	2,520	185	149	2,860	126	102	115	84	40
19	3,160	161	115	2,240	167	132	2,960	267	98	110	84	40
20	3,200	137	110	957	143	1,060	1,760	588	90	106	81	40
21	3,000	161	106	434	126	1,300	714	366	90	106	84	40
22	1,940	197	110	251	267	519	299	642	94	106	81	40
23	948	366	110	185	2,340	126	267	1,740	94	106	84	40
24	696	349	106	149	2,810	106	251	3,100	126	106	84	40
25	383	216	106	161	3,000	98	115	3,450	434	102	81	40
26	315	267	102	155	3,690	102	106	2,740	1,380	102	84	40
27	349	1,070	102	173	4,600	222	94	1,090	2,030	98	81	40
28	417	3,050	98	197	4,170	768	72	417	1,900	98	87	81
29	383	.....	98	173	1,600	267	90	209	485	94	209	115
30	349	.....	94	143	1,150	115	87	126	173	90	120	588
31	235	.....	94	.....	2,010	.....	84	106	.....	87	.....	519

NOTE.—Daily discharge computed from a rating curve fairly well defined between 90 and 3,930 second-feet, and based on measurements made during 1909 and 1910. Daily discharge Jan. 1 to 12 and Dec. 4 to 31 estimated on account of presence of ice.

Monthly discharge of Shoal Creek near Breese, Ill., for 1910.

[Drainage area, 760 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	4,670	.....	1,170	1.54	1.78	C.
February	3,050	115	362	.476	.50	B.
March	6,100	94	1,000	1.32	1.52	B.
April	2,520	87	448	.59	.66	B.
May	4,600	126	1,420	1.87	2.16	B.
June	2,450	98	552	.726	.81	B.
July	2,960	72	571	.751	.87	B.
August	3,450	72	526	.692	.80	B.
September	3,510	90	951	1.25	1.40	B.
October	5,900	87	934	1.23	1.42	B.
November	209	81	89.5	.118	.13	B.
December	588	.....	84.4	.111	.13	B.
The year	5,900	.....	682	.897	12.18	

SILVER CREEK NEAR LEBANON, ILL.

Silver Creek is tributary to Kaskaskia River about 1 mile above New Athens, Ill.

The gaging station, which is located at the highway bridge at Wrights Crossing, about 2 miles west of Lebanon, Ill., between the Baltimore & Ohio Southwestern and East St. Louis & Suburban railway bridges across Silver Creek, was established March 3, 1908, for the purpose of collecting data for use in studying drainage and flood-control problems.

The creek receives no tributaries near the gaging station.

The relation between gage height and discharge is apt to be affected somewhat by ice during parts of December, January, and February.

The datum of the gage has remained unchanged since the gage was installed. From March 3, 1908, to May 10, 1909, this gage was so situated that 2 feet was the lowest obtainable reading, and the gage reader recorded the stream dry whenever the water surface was below 2 feet. On inquiry he stated that the stream was dry for only one week during 1908. To obviate this difficulty the position of the gage was changed on May 10, 1909. Except as noted above, the records are accurate and reliable.

Discharge measurements of Silver Creek near Lebanon, Ill., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 22	H. J. Jackson	31	100	3.00	42
May 27	C. T. Bailey	354	1,260	11.75	[a] 1,000
28	do	53	395	9.24	466
Dec. 8[b]	Bailey and Monk	32	102	3.01	8.9

[a] Flow in three flood channels estimated to be 53 second-feet. [b] Ice present.

Daily gage height, in feet, of Silver Creek near Lebanon, Ill., for 1910.

[E. C. Turner, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.1	3.6	14.6	2.7	3.0	3.8	2.2	2.5	2.25	2.5	3.5	3.25
2	5.4	3.75	13.8	2.6	2.9	3.0	2.2	2.0	2.05	2.5	3.4	3.15
3	5.4	4.0	13.0	2.6	5.0	2.8	4.1	1.9	.....	2.45	3.4	3.1
4	6.2	5.8	12.3	2.7	8.7	2.8	3.2	1.8	.....	3.1	3.4	3.15
5	7.0	6.5	11.6	3.6	8.2	9.5	2.7	1.8	.....	3.1	3.35	3.1
6	8.0	4.7	8.6	4.9	4.5	11.0	2.45	1.6	13.4	11.55	3.45	3.1
7	7.9	3.9	5.6	4.8	5.1	12.0	2.2	2.4	13.2	12.5	3.4	3.1
8	7.7	3.7	4.7	3.8	8.6	11.5	2.1	2.2	12.6	14.4	3.5	2.95
9	6.9	3.6	4.2	3.1	8.1	8.1	2.2	2.25	12.2	13.3	3.45	3.0
10	4.7	3.6	3.9	2.9	5.4	9.5	4.75	2.1	9.7	12.4	3.5	2.85
11	4.9	3.55	3.7	2.7	4.2	6.4	3.2	1.8	4.7	10.75	3.45	2.85
12	7.1	3.5	3.6	2.9	5.5	4.8	6.7	1.65	3.5	5.2	3.05	2.9
13	11.2	3.5	3.5	2.8	6.0	3.4	5.6	1.5	3.0	3.85	3.1	2.85
14	13.9	3.5	3.4	2.7	5.5	3.05	3.4	1.5	2.9	3.55	3.05	.....
15	14.3	4.1	3.25	3.6	4.7	3.1	2.55	1.45	2.6	3.35	3.1	.....

Daily gage height, in feet, of Silver Creek near Lebanon, Ill., for 1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	13.2	5.1	3.2	9.6	3.2	4.3	3.65	1.7	2.7	3.2	3.05	.....
17	12.8	7.6	3.2	10.3	3.1	4.65	8.9	1.7	2.45	3.2	3.1	.....
18	12.2	6.1	3.2	10.6	3.2	3.2	10.4	1.7	2.25	3.15	3.1	.....
19	11.9	5.3	3.2	8.1	3.1	2.9	9.6	1.9	2.4	3.2	3.1	.....
20	12.3	4.9	3.2	5.0	2.9	2.7	4.5	2.2	2.4	3.2	3.15	3.0
21	11.9	4.4	3.15	4.0	2.7	2.9	2.9	2.0	2.4	3.15	3.15	.....
22	11.5	4.5	3.1	3.5	2.6	3.9	2.35	1.7	2.3	3.35	3.15	.....
23	8.7	4.9	3.0	3.3	11.6	2.9	2.2	11.9	2.4	3.25	3.15	.....
24	5.8	4.9	3.0	3.2	13.2	2.5	2.7	11.7	2.65	3.3	3.15	.....
25	4.5	4.5	3.0	3.1	13.8	2.35	2.25	13.7	2.7	3.3	3.2	.....
26	4.5	4.5	3.0	3.1	12.7	2.5	2.85	13.0	2.85	3.25	3.2	.....
27	4.5	11.0	2.9	3.5	12.0	2.6	3.45	11.9	5.0	3.3	3.2	2.9
28	4.5	11.9	2.9	3.4	9.3	4.7	2.6	5.4	4.9	3.25	3.3	3.35
29	4.6	.....	2.9	3.4	7.4	3.25	2.3	3.55	3.6	3.3	3.6	3.65
30	4.3	.....	2.8	3.2	5.1	2.55	2.9	2.7	3.2	3.4	3.5	4.0
31	4.0	.....	2.8	.....	4.6	.....	2.6	2.5	.....	3.45	.....	3.75

NOTE.—Ice present Jan. 1 to 10 and Dec. 8 to 28. From Jan. 1 to 10 gage was read to top of ice.

Daily discharge, in second-feet, of Silver Creek near Lebanon, Ill., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	20	69	3,820	29	41	80	14	23	16	23	64	52
2	100	77	2,980	26	37	41	14	10	11	23	59	47
3	100	92	2,180	26	157	33	98	8	11	22	59	45
4	150	219	1,490	29	504	33	49	7	2,000	45	59	35
5	200	280	1,050	69	447	600	29	7	2,300	45	56	25
6	300	136	492	150	122	860	22	5	2,580	1,030	62	15
7	300	86	203	143	164	1,240	14	20	2,380	1,680	59	11
8	250	74	136	80	492	1,010	12	14	1,780	3,610	64	9
9	200	69	104	45	436	436	14	16	1,400	2,480	62	9
10	120	69	86	37	187	600	140	12	626	1,580	64	9
11	150	66	74	29	104	271	49	7	136	803	62	9
12	335	64	69	37	195	143	298	5.5	64	171	43	9
13	915	64	64	33	235	59	203	4	41	83	45	9
14	3,080	64	59	29	195	43	59	4	37	66	43	9
15	3,500	98	52	69	136	45	24	3.5	26	56	45	9
16	2,380	164	49	613	49	110	72	6	29	49	43	9
17	1,980	385	49	712	45	132	528	6	22	49	45	9
18	1,400	244	49	770	49	49	730	6	16	47	45	9
19	1,190	179	49	436	45	37	613	8	20	49	45	9
20	1,490	150	49	157	37	29	122	14	20	49	47	9
21	1,190	116	47	92	29	37	37	10	20	47	47	9
22	1,010	122	45	64	26	86	18	6	17	56	47	9
23	504	150	41	54	1,050	37	14	1,190	20	52	47	9
24	219	150	41	49	2,380	23	29	1,090	28	54	47	9
25	122	122	41	45	2,980	18	16	2,880	29	54	49	9
26	122	122	41	45	1,880	23	35	2,180	35	52	49	9
27	122	860	37	64	1,240	26	62	1,190	157	54	49	9
28	122	1,190	37	59	576	136	26	187	150	52	54	25
29	129	.....	37	59	365	52	17	66	69	54	69	74
30	110	.....	33	49	164	24	37	29	49	59	64	92
31	92	.....	33	.....	129	.....	26	23	.....	62	.....	77

NOTE.—Daily discharge computed from a rating curve fairly well defined between 29 and 1,780 second-feet. Daily discharge Jan. 1 to 10 and Dec. 3 to 28 estimated, on account of presence of ice.

Monthly discharge of Silver Creek near Lebanon, Ill., for 1910.

[Drainage area, 335 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	3,500	.....	707	2.11	2.43	C.
February	1,190	64	196	.585	.61	B.
March	3,820	33	438	1.31	1.51	B.
April	770	26	137	.409	.46	B.
May	2,980	26	468	1.40	1.61	B.
June	1,240	18	210	.627	.70	B.
July	730	12	110	.328	.38	B.
August	2,880	3.5	291	.869	1.00	B.
September	2,580	11	470	1.41	1.57	B.
October	3,610	22	405	1.21	1.40	B.
November	69	43	53.1	.158	.18	B.
December	.....	.....	21.9	.065	.07	C.
The year	3,820	3.5	294	.878	11.92	

BIG MUDDY RIVER.

GENERAL FEATURES OF AREA DRAINED.

The drainage basin of Big Muddy River lies in southern Illinois. The river rises in the northwestern part of Jefferson County, flows southward to the town of Zeigler, in Franklin County, thence westward to Murphysboro, in Jackson County, and then southward to its junction with the Mississippi about 40 miles above Cairo, Ill. Below Zeigler the river is extremely crooked. The river is about 100 miles long, including bends. The total drainage area is 2,390 square miles. The principal tributaries are Beaucoup Creek, Little Muddy River, Caseys Creek, and Middle Fork Creek, all small streams.

The basin is elliptical in shape, with a major axis about 70 miles long and a minor axis about 50 miles long. The country is level or undulating. The soil is known as "mulatto soil"—a yellowish-brown clay. Winter wheat is the staple crop. The southeastern part is underlain with valuable coal veins, and coal mining is carried on extensively.

The slope of the river is small. Its sources are about 710 feet, and its mouth is about 310 feet above sea level. The banks and bed of the stream are soft and insecure.

The area is timberless except for scattered groves and the growth along the banks of the stream.

The mean annual rainfall is about 42 inches. The winters are mild. Ice does not form very thick, and, as a rule, the snowfall is light and does not last long.

The subject of storage has not been investigated, but owing to the growing demand for water in this section it should receive careful attention.

The basin offers no opportunities for power development. Like the other rivers in central and southern Illinois this stream is subject to high floods and very low water. During floods some sections resemble lakes, high water overflowing the land on each bank for 2 or 3 miles. Backwater from the Mississippi frequently extends to Murphysboro, said to be 60 miles distant following the river, and floods reach the height of 30 feet above low water.

BIG MUDDY NEAR CAMBON, ILL.

This station, which is located at the Chicago, Burlington & Quincy Railroad bridge, about 1 mile north of Cambon railroad station and about 1½ miles east of Plumfield, Ill., was established June 16, 1908, to obtain data for use in studying the problems of drainage, flood control, and navigation.

The Middle Fork of the Big Muddy enters on the left bank about one-fourth mile above the station.

The relation between gage height and discharge may be somewhat affected by ice during parts of December, January, and February.

The datum of the gage has not been changed. The records are reliable and accurate, but records of low-water measurements should be used with caution as collections of drift and trash make such measurements difficult.

Discharge measurements of Big Muddy River near Cambon, Ill., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 23	C. T. Bailey	75	274	6.52	311
24	do	91	358	7.56	457
25	do	100	509	9.00	782
June 4	do	41	31.4	2.30	19.3
Dec. 12	Bailey and Monk	39	27.3	[a] 2.21	14.4

[a] Ice present.

Daily gage height, in feet, of Big Muddy River near Cambon, Ill., for 1910.

[Robert Tackitt, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.45	4.2	18.95	2.25	5.15	2.8	4.1	3.2	3.55	.....	.....	.....
2	2.7	3.9	21.35	2.25	5.35	2.3	3.1	3.2	3.25	.....	.....	.....
3	3.2	3.75	22.35	2.15	3.9	2.3	3.2	2.85	3.9	.....	.....	.....
4	4.0	3.7	22.15	2.2	5.45	2.25	4.2	2.6	.....	.....	.....	.....
5	4.5	3.65	21.25	2.25	5.85	2.25	4.7	2.35	.....	.....	.....	.....
6	6.25	4.0	19.9	2.3	6.55	2.3	5.4	2.25	.....	.....	.....	.....
7	7.65	4.8	18.2	2.3	5.55	2.4	5.65	2.2	.....	.....	.....	.....
8	.....	4.35	17.4	2.35	4.95	2.35	4.35	2.2	.....	.....	.....	.....
9	.....	4.2	15.3	2.55	5.25	2.35	4.2	2.1	.....	.....	.....	.....
10	.....	3.05	10.5	2.6	5.7	2.4	3.0	2.5	.....	.....	.....	.....
11	4.2	3.7	6.15	2.45	6.05	2.5	3.8	2.3	.....	.....	.....	.....
12	.....	3.6	4.8	2.4	6.45	2.2	3.4	2.0	.....	.....	.....	2.2
13	7.0	3.35	4.1	2.35	6.15	2.15	3.1	2.2	.....	.....	.....	2.2
14	8.3	3.4	3.75	4.25	4.1	2.15	2.85	2.0	.....	.....	.....	2.15
15	12.25	3.65	3.4	3.9	4.2	2.15	3.25	1.95	.....	.....	.....	2.15

Daily gage height, in feet, of Big Muddy River near Cambon, Ill., for 1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	13.7	3.75	3.25	4.55	3.85	2.1	5.2	1.9	.....	.....	.....	2.6
17	14.1	3.95	3.2	7.85	3.6	2.1	5.9	1.8	.....	.....	.....	2.6
18	14.9	4.4	3.05	10.15	3.3	2.1	6.3	1.85	.....	.....	.....	2.7
19	15.0	4.75	2.95	.....	3.05	2.5	6.85	1.85	.....	.....	.....	2.5
20	14.9	4.8	2.9	7.7	2.9	2.0	6.45	1.8	.....	.....	.....	2.5
21	14.8	.....	2.75	6.0	2.7	2.0	6.0	1.8	.....	.....	.....	2.4
22	14.7	.....	2.8	.....	2.55	2.0	5.8	1.7	.....	.....	.....	2.4
23	14.05	9.1	2.65	4.25	4.75	1.95	3.85	3.3	.....	.....	.....	2.5
24	13.9	10.9	2.6	3.8	6.3	1.95	3.1	4.3	.....	.....	.....	2.6
25	9.9	11.65	2.65	3.8	8.6	1.95	3.0	6.2	.....	.....	.....	2.6
26	6.55	10.6	2.55	4.15	9.3	1.9	2.9	6.65	.....	.....	.....	2.8
27	5.7	14.75	2.55	6.55	7.9	1.9	2.9	5.05	.....	.....	.....	2.15
28	5.05	16.4	2.45	8.05	4.7	5.3	3.0	4.85	.....	.....	.....	2.25
29	5.0	.....	2.35	7.7	3.9	3.2	5.6	4.45	.....	.....	.....	3.8
30	5.0	.....	2.35	6.15	3.4	5.9	4.3	4.0	.....	.....	.....	6.4
31	4.65	.....	2.35	.....	3.1	.....	4.0	3.8	.....	.....	.....	9.15

NOTE.—Ice present from Jan. 8 to 13 and Feb. 16 to 23. No gage reader from Sept. 4 to Dec. 11.

Daily discharge, in second-feet, of Big Muddy River near Cambon, Ill., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10	94	4,700	16	162	35	89	51	65	.....	.....	.....
2	31	79	6,860	16	181	17	47	51	53	.....	.....	.....
3	51	73	7,900	12	79	17	51	37	79	.....	.....	.....
4	84	71	7,690	14	191	16	94	27	.....	.....	.....	.....
5	110	69	6,760	16	234	16	124	18	.....	.....	.....	.....
6	280	84	5,490	17	318	17	186	16	.....	.....	.....	.....
7	461	132	4,120	17	201	20	212	14	.....	.....	.....	.....
8	350	102	3,560	18	144	18	102	14	.....	.....	.....	.....
9	240	94	2,400	25	171	18	94	11	.....	.....	.....	.....
10	160	45	960	27	217	20	43	23	.....	.....	.....	.....
11	94	71	268	22	256	23	75	17	.....	.....	.....	.....
12	206	67	132	20	304	14	59	8	.....	.....	.....	14
13	376	57	89	18	268	12	47	14	.....	.....	.....	14
14	558	59	73	96	89	12	37	8	.....	.....	.....	12
15	1,350	69	59	79	94	12	53	6	.....	.....	.....	12
16	1,780	50	53	114	77	11	166	5	.....	.....	.....	27
17	1,920	50	51	489	67	11	239	3	.....	.....	.....	27
18	2,240	25	45	890	55	11	286	4	.....	.....	.....	31
19	2,280	40	41	662	45	23	356	4	.....	.....	.....	23
20	2,240	50	39	468	39	8	304	3	.....	.....	.....	23
21	2,200	80	33	250	31	8	250	3	.....	.....	.....	20
22	2,160	100	35	157	25	8	228	1	.....	.....	.....	20
23	1,900	698	29	96	128	6	77	55	.....	.....	.....	23
24	1,850	1,050	27	75	286	6	47	99	.....	.....	.....	27
25	842	1,210	29	75	608	6	43	274	.....	.....	.....	27
26	318	982	25	92	734	5	39	330	.....	.....	.....	35
27	217	2,180	25	318	496	5	39	152	.....	.....	.....	12
28	152	2,950	22	518	124	176	43	136	.....	.....	.....	16
29	148	.....	18	468	79	51	196	107	.....	.....	.....	75
30	148	.....	18	268	59	239	99	84	.....	.....	.....	298
31	120	.....	18	.....	47	.....	84	75	.....	.....	.....	707

NOTE.—Daily discharge computed from a fairly well-defined rating curve based on measurements made 1908–1910. Discharge from Jan. 8 to 10 and from Feb. 16 to 22 estimated on account of presence of ice

Monthly discharge of Big Muddy River near Cambon, Ill., for 1910.

[Drainage area 735 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	2,280	.....	802	1.09	1.26	B.
February	2,950	.....	380	.517	.54	B.
March	7,900	18	1,660	2.26	2.61	B.
April	890	12	178	.242	.27	B.
May	734	25	187	.254	.29	B.
June	239	5	28.0	.038	.04	B.
July	356	37	123	.167	.19	B.
August	330	1	53.2	.072	.08	B.
December (12–31)	707	12	72.2	.098	.07	B.

BEAUCOUP CREEK NEAR PINCKNEYVILLE, ILL.

Beaucoup Creek is tributary to Big Muddy River about 5 miles above Murphysboro in Jackson County.

The gaging station, which is located at the Illinois Central Railroad bridge about 1½ miles east of Pinckneyville, Ill., was established June 17, 1908, for the purpose of obtaining data for use in studying drainage and flood-control problems.

Little Beaucoup Creek enters on the left bank below the gaging station, and Galum Creek on the right bank about 10 miles below the station.

The datum of the gage has remained unchanged since the gage was installed.

The relation between gage height and discharge may be somewhat affected by ice during parts of December, January, and February.

The flood of 1902 reached a height representing about 27.5 feet on the present gage. The creek goes dry at times; the water then stands in pools near the gage.

Discharge measurements of Beaucoup Creek near Pinckneyville, Ill., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 22	C. T. Bailey	65	75	2.41	9.2
24	.....do	122	538	7.24	373
25	.....do	104	309	5.28	147
Dec. 13[a]	Bailey and Monk	5	1.4	2.27	1.3

[a] Not at regular gaging section.

Daily gage height, in feet, of Beaucoup Creek near Pinckneyville, Ill., for 1910.

[R. C. Huggins, observer.]

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	2.85	19.85	2.15	2.9	2.1	.....	2.1	1.95	2.15	2.25	2.45
2	2.4	2.7	17.25	2.2	2.8	2.1	1.9	2.05	2.0	.....	2.15	2.35
3	2.55	2.8	15.9	2.15	4.0	2.05	.....	2.0	2.3	2.05	2.2	2.35
4	4.2	2.95	9.45	2.2	8.15	2.0	5.2	1.9	.....	10.25	2.15	2.35
5	3.8	3.0	6.2	2.25	5.1	.....	6.0	1.9	8.65	.....	2.15	2.35
6	4.0	3.1	5.45	2.95	3.75	2.1	5.7	1.8	13.8	15.7	.....	2.35
7	5.4	3.0	4.4	2.3	3.85	2.05	.....	.....	15.2	16.1	2.2	2.35
8	4.2	3.05	3.85	2.2	.....	2.0	3.5	1.9	17.9	17.0	2.15	2.35
9	3.8	2.8	3.45	2.4	5.55	2.25	2.75	1.8	17.4	.....	.....	2.3
10	2.4	2.75	3.3	2.3	4.2	2.4	.....	1.8	17.0	3.75	.....	2.3
11	2.5	2.7	3.1	2.25	3.55	2.25	2.6	1.8	4.65	.....	.....	2.3
12	2.35	2.6	2.95	2.6	3.6	2.15	.....	1.8	3.45	2.75	.....	2.3
13	7.55	2.75	2.95	2.35	3.55	2.1	2.25	1.7	2.9	2.65	.....	2.3
14	13.2	2.9	2.8	2.95	3.25	2.1	2.25	.....	2.55	2.5	.....	2.3
15	14.8	3.0	2.8	2.9	3.05	2.1	2.2	1.7	2.4	2.4	.....	2.25
16	10.3	3.05	2.65	3.15	2.7	2.1	2.7	1.75	2.3	.....	.....	2.25
17	5.55	3.15	2.6	.....	3.0	2.05	5.7	1.75	2.25	2.3	.....	2.25
18	8.0	3.35	2.55	5.25	2.45	2.0	3.75	1.75	2.2	2.25	2.1	2.25
19	14.05	3.4	2.55	4.15	2.4	1.95	.....	.....	2.1	2.3	.....	2.25
20	9.8	3.5	2.55	.....	2.65	1.9	.....	1.7	.....	2.3	2.1	2.2
21	7.3	3.5	2.45	3.25	2.6	1.9	.....	.....	2.1	2.3	2.1	2.2
22	6.2	4.6	2.45	3.0	2.4	1.9	2.05	1.7	2.05	2.3	.....	.....
23	4.45	6.05	2.45	2.75	3.7	1.8	2.0	2.1	2.05	.....	.....	.....
24	3.45	5.35	2.4	2.7	7.0	1.8	.....	9.8	2.0	2.25	.....	.....
25	3.2	5.0	2.4	2.65	5.4	1.75	2.0	6.5	.....	2.3	.....	2.25
26	3.1	4.15	2.35	2.65	3.7	.....	2.0	4.8	2.1	.....	.....	2.25
27	3.0	14.2	2.3	3.3	3.05	1.7	2.0	3.3	.....	2.2	.....	2.2
28	3.45	21.1	2.3	4.05	2.7	2.9	3.25	.....	.....	2.25	.....	2.5
29	4.0	.....	2.25	3.85	2.45	2.2	2.65	2.55	.....	.....	.....	2.8
30	3.6	.....	2.25	3.25	2.3	2.05	2.4	2.3	.....	2.2	.....	4.05
31	2.95	.....	2.2	.....	2.2	.....	.....	2.2	.....	2.15	.....	4.8

NOTE.—Relation between gage height and discharge slightly affected by ice during February; ice present during December.

Daily discharge, in second-feet, of Beaucoup Creek near Pinckneyville, Ill., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4	26	2,000	5	28	4	4	4	3	5	7	8
2	11	20	1,640	6	24	4	3	3.5	3	4	5	7
3	16	24	1,450	5	80	4	80	3	8	3.5	6	7
4	92	30	574	6	430	3	163	3	240	672	5	6
5	70	32	245	7	155	4	227	3	484	1,050	5	6
6	80	36	183	30	68	4	203	2	1,150	1,420	6	5
7	179	32	105	8	72	4	129	2	1,350	1,470	6	5
8	92	34	72	6	126	3	55	3	1,730	1,600	5	4
9	70	24	52	11	191	7	22	2	1,660	834	4	3
10	11	22	45	8	92	11	20	2	1,600	68	4	2
11	14	20	36	7	58	7	17	2	122	45	4	2
12	10	17	30	17	60	5	12	2	52	22	4	1
13	368	22	30	10	58	4	7	2	28	18	4	1
14	1,070	28	24	30	42	4	7	2	16	14	4	1
15	1,290	32	24	28	34	4	6	2	11	11	4	1
16	679	34	18	38	20	4	20	2	8	10	4	1
17	191	38	17	92	32	4	203	2	7	8	4	1
18	413	48	16	167	12	3	68	2	6	7	4	1
19	1,190	50	16	89	11	3	52	2	4	8	4	1
20	616	55	16	65	18	3	36	2	4	8	4	1
21	344	55	12	42	17	3	20	2	4	8	4	1
22	245	119	12	32	9	3	3	2	3.5	8	4	1
23	108	232	12	22	65	2	3	4	3.5	8	4	1
24	52	175	11	20	317	2	3	616	3	7	4	1
25	40	147	11	18	179	2	3	272	4	8	6	1
26	36	89	10	18	65	2	3	133	4	7	6	1
27	32	1,210	8	45	34	2	3	45	4	6	8	1
28	52	2,170	8	83	20	28	42	16	4	7	10	8
29	80	.....	7	72	12	6	18	16	4	6	10	24
30	60	.....	7	42	8	4	11	8	4	6	11	83
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NOTE.—Daily discharge computed from a rating curve fairly well defined below 640 second-feet. Daily discharge during November was interpolated, and during December estimated because of presence of ice.

Monthly discharge of Beaucoup Creek near Pinckneyville, Ill., for 1910.

[Drainage area, 227 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	1,290	4	243	1.07	1.23	B.
February	2,170	17	172	.758	.79	C.
March	2,000	6	216	.952	1.10	C.
April	167	5	34.3	.151	.17	B.
May	430	6	75.6	.333	.38	B.
June	28	2	4.8	.021	.02	C.
July	227	3	46.2	.204	.24	B.
August	616	2	37.7	.166	.19	B.
September	1,730	3	284	1.25	1.40	B.
October	1,600	4	237	1.04	1.20	B.
November	11	4	5.33	.023	.03	C.
December	133	.....	10.3	.045	.05	D.
The year	2,170	.....	114	.502	6.80	

MISCELLANEOUS MEASUREMENTS.

HUDSON BAY DRAINAGE BASIN.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
1910.				*Feet.*	*Sec.-ft.*
Nov. 20	St. Mary River	Belly River	Kimball, Alberta	3.12	681
Dec. 13	Red River	Nelson River	Grand Forks above Red Lake River.	3.74	101
July 2	Red Lake River	Red River	Just below Clearwater River.	.....	716
Aug. 10	.....do	.....do		6.50	393
Oct. 16	.....do	.....do		6.10	328
Aug. 20	.....do	.....do	Just above mouth	3.37	214

UPPER MISSISSIPPI RIVER DRAINAGE BASIN.

Mar. 30	Spoon River	Illinois River	Seville, Ill.	(*a*)	627
31	.....do	.....do	Maquon, Ill.	(*b*)	302
Apr. 1	.....do	.....do	Dahinda, Ill.	(*c*)	235
1	.....do	.....do	Elmore, Ill.	(*d*)	155
2	.....do	.....do	Near Wyoming, Ill.	(*e*)	86
5	Sugar Creek	Sangamon River	Hartsburg, Ill.	(*f*)	76

a 30.65 feet to water surface from top of downstream end of third-floor beam from right abutment of Toledo, Peoria & Western Railway bridge east of Seville.

b 25.70 feet to water surface from base of rail 135 feet from face of coping of right abutment. Downstream side of Chicago, Burlington & Quincy Railroad bridge.

c 26.04 feet to water surface from top of handrail on downstream side of bridge; 59 feet from center of right tubular pier.

d 22.61 feet to water surface from top of downstream end of floor beam 79 feet from base of left abutment. Bridge is East Bridge above mouth of Walnut Creek.

e 15.26 feet to water surface from top of northeast corner of upstream end of floor beam 39 feet from face of left plank abutment.

f 17.55 feet to water surface from top of third-floor beam left end of bridge, downstream side.

SUMMARY OF MEAN DISCHARGE PER SQUARE MILE.

The following summary of discharge per square mile is given to allow ready comparison of relative rates of run-off from different areas in the Hudson Bay and upper Mississippi drainage basins.

It shows in a general way the seasonal distribution of run-off, and the effect of snow, ground, surface, and artificial storage. The most important fact worth noting is the almost entire lack of uniformity or agreement between any two streams, which indicates that the discharge of each stream is a law unto itself, and that all projects dependent upon stream flow, if they are to be developed along the safest and most economical lines, must be based on records of stream flow collected with great care over a long series of years as near the location of the project under consideration as possible.

Summary of discharge, in second-feet per square mile, in Hudson Bay and upper Mississippi River basins for 1910.

	Drainage area.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
	Sq. mi.													
St. Mary River near Babb, Mont.	177	0.51	0.56	0.96	2.93	7.06	7.80	4.48	2.05	1.44	3.24	2.45	1.09	2.88
St. Mary River, below Swiftcurrent Creek	298	....	....	....	....	....	6.34	3.83	1.77	1.40	3.46	2.15	.93	....
St. Mary River near Cardston, Alberta	452	.33	.35	1.17	2.63	5.13	4.96	2.59	1.28	1.22	2.30	1.64	.65	2.03
Swiftcurrent Creek near Babb, Mont.	101	.40	.45	1.34	4.47	....	....	....	....	....	....	....	....	....
Ottertail River near Fergus Falls, Minn	1,310	.25	.17	.22	.33	.32	.22	.12	.05	.02	.04	.06	.06	.16
Red River at Fargo, N. Dak.	6,020	....	....	.35	.24	.16	.08	.04	.01	.01	.01	.01	....	....
Red River at Grand Forks, N. Dak.	25,000	.06	.05	.34	.31	.17	.08	.03	.02	.02	.02	.02	.01	.09
Pelican River near Fergus Falls, Minn.	433	.29	.18	.42	.43	.34	.16	.04	.02	.01	.02	.03	.01	.16
Wild Rice River at Twin Valley, Minn.	805	....	....	....	.69	.70	.34	.07	.03	.03	.03	.03	.02	....
Red Lake River at Thief River Falls	3,430	.16	.16	.64	.66	.39	.23	.12	....	....	....	....	....	....
Red Lake River at Crookston, Minn.	5,320	.14	.13	.68	.77	.37	.20	.10	.07	.06	.06	.04	.04	.22
Thief River near Thief River Falls	1,010	.10	.04	.33	1.14	.43	.16	.11	.04	.01	.00	.00	.00	.20
Clearwater River at Red Lake Falls, Minn.	1,310	.17	.09	.51	.99	.25	.09	.03	.03	.03	.04	.04	.04	.19
Pembina River at Neche, N. Dak.	2,940	....	....	....	.06	.04	.02	.01	.00	.00	.00	....	....	....
Mouse River at Minot, N. Dak.	8,400	.00	.00	.02	.02	.01	.01	.00	.00	.00	.00	.00	.00	.00
Little Fork River at Little Fork, Minn.	1,720	....	....	....	....	.41	.18	.09	.07	.05	.10	.09	....	....
Big Fork River at Big Falls, Minn.	1,320	....	....	....	2.33	1.25	.54	.11	.05	.08	.22	....	....	....
Mississippi River above Sandy River, Minn.	4,510	.25	.29	.49	.58	.54	.47	.48	.60	.58	.42	.26	.15	.43
Mississippi River at Anoka, Minn.	17,100	.23	.22	.54	.47	.34	.26	.22	.20	.20	.21	.17	.11	.26
Mississippi River at St. Paul, Minn.	35,700	.14	.13	.60	.39	.26	.18	.11	.11	.11	.12	.10	.06	.19
Pine River below Pine River reservoir, Minn.	452	.69	1.36	1.45	1.45	1.43	1.27	.34	.17	.24	.46	.16	.16	.76
Crow Wing River at Pillager, Minn.	3,230	.24	.21	.70	.60	.34	.20	.11	.09	.14	.19	.16	.14	.26
Long Prairie River near Motley, Minn.	973	....	....	....	.42	.21	.14	.07	.07	.09	.09	....	....	....
Sauk River near St. Cloud, Minn.	816	.12	.10	.58	.41	.11	.09	.05	.06	.07	.07	.04	.02	.14
Crow River at Rockford, Minn.	2,520	.11	.08	.59	.20	.10	.05	.03	.02	.02	.03	.03	.03	.11
South Fork of Crow River near Rockford, Minn.	....	....	....	....	.17	.10	.08	.04	.01	.00	.02	.03	....	....
Rum River at Onamia, Minn.	414	.16	.18	.46	.82	.55	.30	.07	.04	.01	.02	.01	.01	.22
Rum River at Cambridge, Minn.	1,160	.13	.12	.64	.44	.25	.14	.08	.07	.07	.07	.07	.05	.18
Minnesota River near Odessa, Minn.	1,560	....	....	....	.18	.14	.05	.01	.01	.02	.03	....	....	....
Minnesota River near Montevideo, Minn.	6,300	.03	.02	.27	.22	.15	.06	.02	.01	.01	.02	.02	.01	.07
Minnesota River near Mankato, Minn.	14,600	.06	.04	.53	.18	.13	.07	.03	.02	.02	.02	.02	.02	.09
Chippewa River near Watson, Minn.	1,940	....	....	....	....	.10	.02	.01	.01	.01	.01	....	....	....
Redwood River near Redwood Falls, Minn.	703	....	....	....	.12	.04	.04	.01	.01	.01	.02	....	....	....
Cottonwood River near New Ulm, Minn.	1,190	....	....	....	.25	.07	.08	.03	.02	.01	.01	.02	....	....
Blue Earth River at Rapidan Mills, Minn.	2,260	....	....	....	.20	.07	.06	.02	.02	.02	.03	....	....	....
Kettle River near Sandstone, Minn.	825	.22	.20	.95	.76	.33	.22	.09	.09	.13	.16	.12	.10	.28
Snake River at Mora, Minn.	422	.14	.08	.93	.47	.15	.11	.09	.16	.13	.09	.09	.04	.21
Cannon River at Welch, Minn.	1,290	....	....	....	.34	.22	.19	.13	.11	.10	.10	.10	....	....
Zumbro River at Zumbro Falls, Minn.	1,120	.33	.26	1.06	.33	.27	.19	.15	.15	.15	.14	.15	.14	.28
Root River near Houston, Minn.	1,560	.32	.29	.72	.35	.32	.25	.21	.22	.30	.22	.22	.20	.30

Summary of discharge, in second-feet per square mile, in Hudson Bay and upper Mississippi River basins for 1910—Continued.

	Drainage area.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Wapsipinicon River at Stone City, Iowa	*Sq. mi.* 1,310	....	....	1.91	0.46	0.31	0.18	0.08	0.08	0.11	0.11	0.08	....	....
Cedar River near Austin, Minn	425	0.24	0.19	1.50	.23	.16	.12	.12	.12	.12	.12	.12	0.09	0.26
Des Moines River at Jackson, Minn	1,160	....	....	....	.17	.07	.05	.03	.02	.02	.02	.03	....	....
Sangamon River near Monticello, Ill	550	1.32	.60	.67	.17	.70	.33	.11	.04	.16	.08	.04	.16	.35
Sangamon River at Riverton, Ill	2,560	1.21	.49	.82	.25	1.23	.48	.34	.12	.16	.13	.13	.25	.47
Sangamon River near Oakford, Ill	5,000	1.86	.54	.70	.27	.81	.48	.26	.11	.18	.11	.07	.15	.40
South Fork Sangamon River near Taylorville, Ill	427	1.35	.42	.94	.26	1.61	.27	.31	.16	.34	.19	.09	.50	.54
Salt Creek near Kenney, Ill	459	1.19	.40	.49	.15	.38	.09	.05	.06	.04	.06	.03	.13	.26
Cahokia Creek near Poag, Ill	259	2.05	.46	.97	.39	1.25	.62	.32	.05	1.05	1.39	.28	.17	.75
Kaskaskia River near Arcola, Ill	390	1.92	.71	.99	.33	1.25	.44	.56	.20	.49	.18	.12	.54	.65
Kaskaskia River at Shelbyville, Ill	1,030	1.86	.66	1.18	.27	1.79	.48	.56	.35	.62	.33	.43	.49	.76
Kaskaskia River at Vandalia, Ill	1,980	1.31	.58	1.05	.28	1.55	.46	.67	.30	.38	.38	.15	.38	.63
Kaskaskia River at Carlyle, Ill	2,680	1.41	.59	1.29	.26	1.09	.66	.62	.26	.39	.60	.09	.27	.63
Kaskaskia River at New Athens, Ill	5,220	1.72	.62	2.01	.35	1.15	.76	.66	.45	1.32	1.19	.08	.18	.88
Shoal Creek near Breese, Ill	760	1.54	.48	1.32	.59	1.87	.73	.75	.69	1.25	1.23	.12	.11	.90
Silver Creek near Lebanon, Ill	335	2.11	.58	1.31	.41	1.40	.63	.33	.87	1.41	1.21	.16	.06	.88
Big Muddy River at Cambon, Ill	735	1.09	.52	2.26	.24	.25	.04	.17	.07	....	....	....	....	....
Beaucoup Creek near Pinckneyville, Ill	227	1.07	.76	.95	.15	.33	.02	.20	.17	1.25	1.04	.02	.04	.50

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DEPARTMENT OF THE INTERIOR
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GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPER 286

SURFACE WATER SUPPLY OF THE UNITED STATES

1910

PART VI. MISSOURI RIVER BASIN

PREPARED UNDER THE DIRECTION OF M. O. LEIGHTON

BY

W. A. LAMB, W. B. FREEMAN, RAYMOND RICHARDS
AND R. C. RICE

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SURFACE WATER SUPPLY OF MISSOURI RIVER BASIN, 1910.

By W. A. Lamb, W. B. Freeman, Raymond Richards, and R. C. Rice.

INTRODUCTION.

AUTHORITY FOR INVESTIGATIONS.

This volume contains results of measurements of the flow of certain streams in the United States. The work was performed by the United States Geological Survey, either independently or in cooperation with private or State organizations. The organic law of the Geological Survey (Stat. L., vol. 20, p. 394) contains the following paragraph:

Provided, That this officer [the Director] shall have the direction of the geological survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

As water is the most abundant and most valuable of the minerals the investigation of water resources is authorized under the provision for examining mineral resources. The work has been supported since the fiscal year ending June 30, 1895, by appropriations in successive sundry civil bills passed by Congress under the following item:

For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

The various appropriations that have been made for this purpose are as follows:

Annual appropriations for the fiscal year ending June 30—

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000
1911	150,000

SCOPE OF INVESTIGATIONS.

These investigations are not complete nor are they inclusive of all the streams that might purposefully be studied. The scope of the work is limited by the appropriations available. The field covered is the widest and the character of the work is believed to be the best possible under the controlling conditions. The work would undoubtedly have greater scientific importance and ultimately be of more practical value if the money now expended for wide areas were concentrated on a few small drainage basins; but such a course is impossible because general appropriations made by Congress are applicable to all parts of the country. Each part demands its proportionate share of the benefits.

It is essential that records of stream flow shall be kept during a period of years long enough to determine within reasonable limits the entire range of flow from the absolute maximum to the absolute minimum. The length of such a period manifestly differs for different streams. Experience has shown that the records for some streams should cover 5 to 10 years, and those for other streams 20 years or even more, the limit being determined by the relative importance of the stream and the interdependence of the results with other long-time records on adjacent streams.

In the performance of this work an effort is made to reach the highest degree of precision possible with a rational expenditure of time and a judicious expenditure of a small amount of money. In all engineering work there is a point beyond which refinement is needless and wasteful, and this statement applies with especial force to stream-flow measurements. It is confidently believed that the stream-flow data presented in the publications of the Survey are in general sufficiently accurate for all practical purposes. Many of the records are, however, of insufficient length, owing to the unforeseen reduction of appropriations and consequent abandonment of stations. All persons are cautioned to exercise the greatest care in using such incomplete records.

Records have been obtained at nearly 2,000 different points in the United States. The surface water supply of small areas in Seward Peninsula and the Yukon-Tanana region, Alaska, and in Hawaii has also been investigated. During 1910 regular gaging stations were maintained by the Survey and cooperating organizations at about 1,100 points in the United States, and many discharge measurements were made at other points. Data were also obtained in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country, and will be made available in the regular surface water-supply papers and in special papers from time to time.

PUBLICATIONS.

The data on stream flow collected by the United States Geological Survey have appeared in the annual reports, bulletins, and water-supply papers. Owing to natural processes of evolution and to changes in governmental requirements the character of the work and the territory covered by these different publications have varied greatly. For the purpose of uniformity in the presentation of reports a general plan has been agreed upon by the United States Reclamation Service, the United States Forest Service, the United States Weather Bureau, and the United States Geological Survey, according to which the area of the United States has been divided into twelve parts, whose boundaries coincide with certain natural drainage lines. The areas so described are indicated by the following list of papers on surface water supply for 1910. The dividing line between the north Atlantic and south Atlantic drainage areas lies between York and James rivers.

Papers on surface water supply of the United States, 1910.

Part.	No.	Title.
I	281	North Atlantic coast.
II	282	South Atlantic coast and eastern Gulf of Mexico.
III	283	Ohio River basin.
IV	284	St. Lawrence River basin.
V	285	Upper Mississippi River and Hudson Bay basins.
VI	286	Missouri River basin.
VII	287	Lower Mississippi River basin.
VIII	288	Western Gulf of Mexico.
IX	289	Colorado River basin.
X	290	Great basin.
XI	291	California.
XII	292	North Pacific coast.

The following table gives the character of data regarding stream flow at regular stations to be found in the various publications of the United States Geological Survey, exclusive of special papers:

Stream-flow data in reports of the United States Geological Survey.

[A.=Annual Report; B.=Bulletin; W S.=Water-Supply Paper.]

Report.	Character of data.	Year.
10th A., pt. 2	Descriptive information only	
11th A., pt. 2	Monthly discharge	1884 to Sept., 1890.
12th A., pt. 2	do	1884 to June 30, 1891.
13th A., pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th A., pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B. 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th A., pt. 2	Descriptive information only	
B. 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
W S. 11	Gage heights (also gage heights for earlier years).	1896.
18th A., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for earlier years).	1895 and 1896.
W S. 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.

Stream-flow data in reports of the United States Geological Survey—Continued.

Report.	Character of data.	Year.
W S. 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th A., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W S. 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W S. 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th A., pt. 4	Monthly discharge (also for many earlier years)	1898.
W S. 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st A., pt. 4	Monthly discharge	1899.
W S. 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d A., pt. 4	Monthly discharge	1900.
W S. 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W S. 75	Monthly discharge	1901.
W S. 82 to 85	Complete data	1902.
W S. 97 to 100	....do	1903.
W S. 124 to 135	....do	1904.
W S. 165 to 178	....do	1905.
W S. 201 to 214	Complete data, except descriptions	1906.
W S. 241 to 252	Complete data	1907–8.
W S. 261 to 272	....do	1909.
W S. 281 to 292	....do	1910.

NOTE.—No data regarding stream flow are given in the fifteenth and seventeenth annual reports.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing records prior to 1904 has been published in Water-Supply Paper 119.

The first table which follows gives, by years and drainage basins, the numbers of the papers on surface water supply published from 1899 to 1910. Wherever the data for a drainage basin appear in two papers the number of one is placed in parentheses and the portion of the basin covered by that paper is indicated in the second table. For example, in 1904 the data for Missouri River were published in Water-Supply Papers 130 and 131, and the portion of the records contained in Water-Supply Paper 131, as indicated by the second table, is that relating to Platte and Kansas rivers.

Numbers of water-supply papers containing results of stream measurements, 1899–1910.

	1899[a]	1900[b]	1901	1902	1903
Atlantic coast and eastern Gulf of Mexico:					
New England rivers	35	47	65,75	82	97
Hudson River to Delaware River, inclusive	35	47,(48)	65,75	82	97
Susquehanna River to York River, inclusive	35	48	65,75	82	97
James River to Yadkin River, inclusive	(35),36	48	65,75	(82),83	(97),98
Santee River to Pearl River, inclusive	36	48	65,75	83	98
St. Lawrence River	36	49	65,75	(82),83	97
Hudson Bay			66,75	85	100
Mississippi River:					
Ohio River	36	48,(49)	65,75	83	98
Upper Mississippi River	36	49	65,75	83	98,(99)
Missouri River	(36),37	49,(50)	66,75	84	99
Lower Mississippi River	37	50	(65), 66,75	(83),84	(98),99
Western Gulf of Mexico	37	50	66,75	84	99
Pacific coast and Great Basin:					
Colorado River	(37),38	50	66,75	85	100
Great Basin	38,(39)	51	66,75	85	100
South Pacific coast to Klamath River, inclusive	(38),39	51	66,75	85	100
North Pacific coast	38	51	66,75	85	100

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39.
[b] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52.

Numbers of water-supply papers containing results of stream measurements, 1899–1910—Continued.

	1904	1905	1906	1907–8	1909	1910
Atlantic coast and eastern Gulf of Mexico:						
New England rivers	124	165	201	241	261	281
Hudson River to Delaware River, inclusive	125	166	202	241	261	281
Susquehanna River to York River, inclusive	126	167	203	241	261	281
James River to Yadkin River, inclusive	126	167	203	242	262	282
Santee River to Pearl River, inclusive	127	168	204	242	262	282
St. Lawrence River	129	170	206	244	264	284
Hudson Bay	130	171	207	245	265	285
Mississippi River:						
Ohio River	128	169	205	243	263	283
Upper Mississippi River	128, (130)	171	207	245	265	285
Missouri River	130, (131)	172	208	246	266	286
Lower Mississippi River	(128), 131	(169), 173	(205), 209	247	267	287
Western Gulf of Mexico	132	174	210	248	268	288
Pacific coast and Great Basin:						
Colorado River	133, (134)	175, (177)	211, (213)	249, (251)	269, (271)	289, (291)
Great Basin	133, (134)	176, (177)	212, (213)	250, (251)	270, (271)	290, (291)
South Pacific coast to Klamath River, inclusive	134	177	213	251	271	291
North Pacific coast	135	(177), 178	214	252	272	292

Numbers of water-supply papers containing data covering portions of drainage basins.

No.	River basin.	Tributaries included.
35	James	
36	Missouri	Gallatin.
37	Colorado	Green, Gunnison, Grand above junction with Gunnison.
38	Sacramento	Except Kings and Kern.
39	Great Basin	Mohave.
48	Delaware	Wissahickon and Schuylkill.
49	Ohio	Scioto.
50	Missouri	Loup and Platte near Columbus, Nebr. All tributaries below junction with Platte.
65	Lower Mississippi	Yazoo.
82	James	
	St. Lawrence	Lake Ontario, tributaries to St. Lawrence River proper.
83	Lower Mississippi	Yazoo.
97	James	
98	Lower Mississippi	Do.
99	Upper Mississippi	Tributaries from the west.
128	Lower Mississippi	Yazoo.
130	Upper Mississippi	Tributaries from the west.
131	Missouri	Platte, Kansas.
134	Colorado	Data near Yuma, Ariz., repeated.
	Great Basin	Susan, Owens, Mohave.
169	Lower Mississippi	Yazoo.
177	Colorado	Below junction with Gila.
	Great Basin	Susan repeated, Owens, Mohave.
	North Pacific coast	Rogue, Umpqua, Siletz.
205	Lower Mississippi	Yazoo, Homochitto.
213	Colorado	Data at Hardyville repeated; at Yuma, Salton Sea.
	Great Basin	Owens, Mohave.
251	Colorado	Yuma and Salton Sea stations repeated.
271		
291	Great Basin	Owens River basin.

The order of treatment of stations in any basin in these papers is downstream. The main stem of any river is determined by measuring or estimating the drainage area; that is, the headwater stream having the largest drainage area is considered the continuation of the main stream, and local changes in name and lake surface are disregarded. Records for all stations from the source to the mouth of the main stem of the river are presented first, and records for the tributaries in regular order from source to mouth follow, all records in each tributary basin being given before those of the next basin below.

The exceptions to this rule occur in the records for Mississippi River, which are given in four parts, as indicated above, and in the records for large lakes, where it is simpler to take up the streams in regular order around the rim of the lake than to cross back and forth over the lake surface.

DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and run-off in second-feet per square mile, and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. The units used in this series of reports are second-feet, feet per square mile, and run-off in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed by the use of the factors given in the following table of equivalents.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work.

CONVENIENT EQUIVALENTS.

The following is a list of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet or 13.572 inches deep.
1 second-foot for one year equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot for one day covers 1 square mile 0.03719 inch deep.
1 second-foot for one 28-day month covers 1 square mile 1.041 inches deep.
1 second-foot for one 29-day month covers 1 square mile 1.079 inches deep.
1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.
1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep.
1 second-foot for one day equals 1.983 acre-feet.
1 second-foot for one 28-day month equals 55.54 acre-feet.
1 second-foot for one 29-day month equals 57.52 acre-feet.
1 second-foot for one 30-day month equals 59.50 acre-feet.
1 second-foot for one 31-day month equals 61.49 acre-feet.
100 California miner's inches equals 18.7 United States gallons per second.
100 California miner's inches equals 96.0 Colorado miner's inches.
100 California miner's inches for one day equals 4.96 acre-feet.
100 Colorado miner's inches equals 2.60 second-feet.
100 Colorado miner's inches equals 19.5 United States gallon per second.
100 Colorado miner's inches equals 104 California miner's inches.
100 Colorado miner's inches for one day equals 5.17 acre-feet.
100 United States gallons per minute equals 0.223 second-foot.
100 United States gallons per minute for one day equals 0.442 acre-foot.
1,000,000 United States gallons per day equals 1.55 second-feet.
1,000,000 United States gallons equals 3.07 acre-feet.
1,000,000 cubic feet equals 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-feet.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.
1⅓ horsepower equals about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel realizing 80 per cent of theoretical power.

EXPLANATION OF DATA.

For each drainage basin there is given a brief general description covering such items as area, source, tributaries, topography, geology, forestation, rainfall, irrigation, storage, power, and other interesting or important facts.

For each regular current-meter gaging station the following data, so far as available, are given: Description of station, list of discharge measurements, table of daily gage heights, table of daily discharges, table of monthly and yearly discharges and run-off. For stations located at weirs or dams the gage-height table is omitted.

In addition to statements regarding the location and installation of current-meter stations, the descriptions give information in regard to any conditions which may affect the constancy of the relation of gage height to discharge, covering such points as ice, logging, shifting channels, and backwater; also information regarding diversions which decrease the total flow at the measuring section. Statements are also made regarding the accuracy and reliability of the data.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, name of hydrographer, width and area of cross section, gage height, and discharge in second-feet.

The table of daily gage heights records the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. At most stations the gage is read in the morning and in the evening. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. All gage heights affected by the presence of ice in the streams or by backwater from obstructions are published as recorded, with suitable footnotes. The rating table is not applicable for such periods unless the proper corrections to the gage heights are known and applied. Attention is called to the fact that the zero of the gage is placed at an arbitrary datum and has no relation to zero flow or the bottom of the river. In general the zero is located somewhat below the lowest known flow, so that negative readings shall not occur.

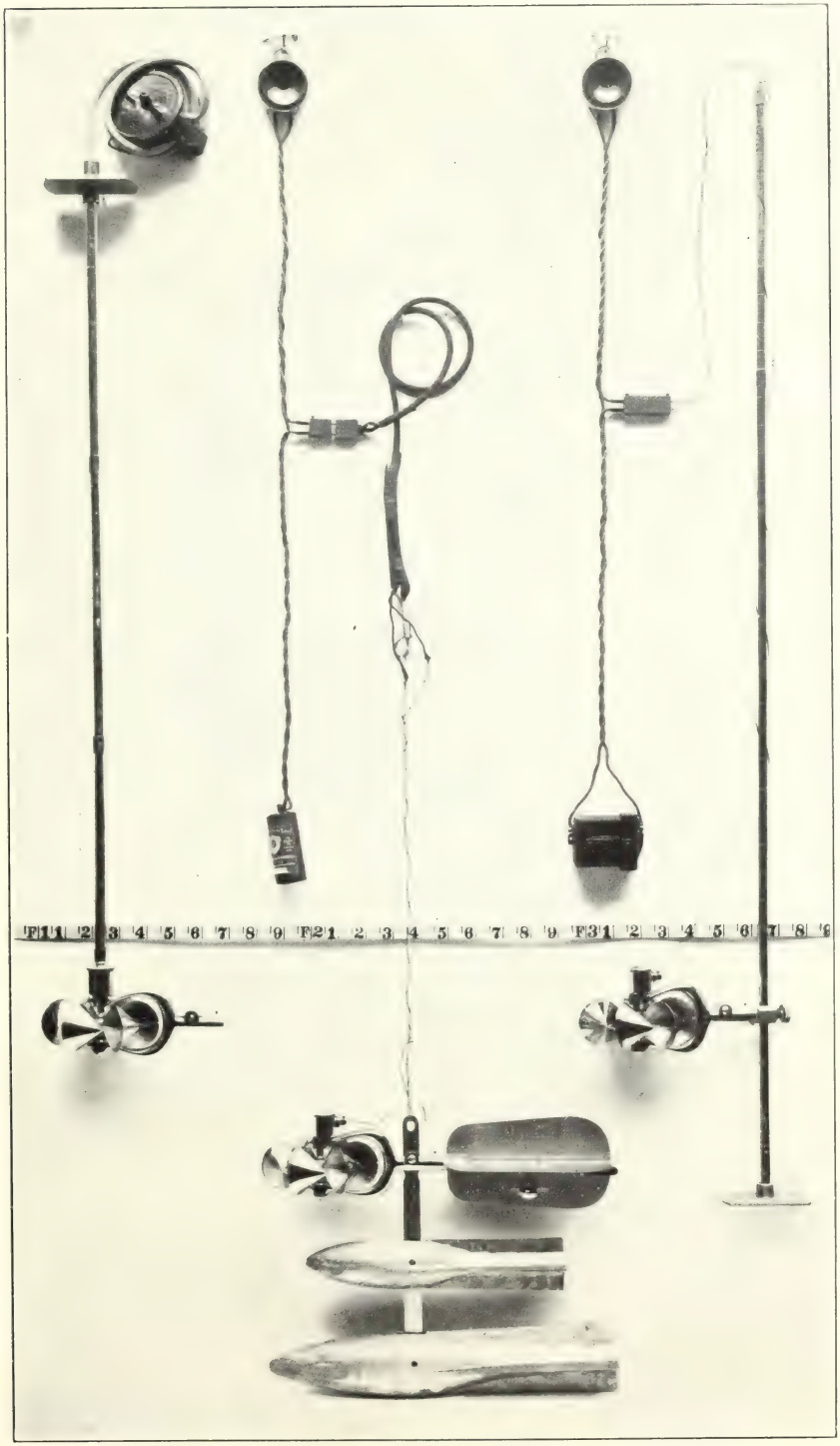
The discharge measurements and gage heights are the base data from which rating tables, daily discharge tables, and monthly discharge tables are computed.

The rating table gives, either directly or by interpolation, the discharge in second-feet corresponding to every stage of the river recorded during the period for which it is applicable. It is not published in this report, but can be determined from the daily gage heights and daily discharges for the purpose of verifying the published results as follows:

A. FOR BRIDGE MEASUREMENT.

B. FOR WADING MEASUREMENT.

TYPICAL GAGING STATIONS.



SMALL PRICE CURRENT METERS.

First plot the discharge measurements for the current and earlier years on cross-section paper, with gage heights in feet as ordinates and discharge in second-feet as abscissas. Then tabulate a number of gage heights taken from the daily gage-height table for the complete range of stage given and the corresponding discharges for the days selected from the daily discharge table and plot the values on cross-section paper. The last points plotted will define the rating curve used and will lie among the plotted discharge measurements. After drawing the rating curve, a table can be developed by scaling off the discharge in second-feet for each tenth foot of gage height. These values should be so adjusted that the first differences shall always be increasing or constant, except for known backwater periods.

The table of daily discharges gives the discharges in second-feet corresponding to the observed gage heights as determined from the rating tables.

In the table of monthly discharge the column headed "Maximum" gives the mean flow, as determined from the rating table, for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the stage when the water surface was at crest height and the corresponding discharge was consequently larger than given in the maximum column. Likewise, in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this the computations for the remaining columns, which are defined on page 6, are based.

The field methods used in the collection of the data presented in this series of reports are described in the introductory sections of Water-Supply Papers 261 to 272, inclusive, "Surface water supply of the United States, 1909." Plate I shows typical gaging stations, indicating the method of suspending the current meter;. Plate II shows the various types of current meters [1] used in the work. A sample rating curve is shown in figure 1 (p. 166).

ACCURACY AND RELIABILITY OF FIELD DATA AND COMPARATIVE RESULTS.

The accuracy of stream-flow data depends primarily on the natural conditions at the gaging station and on the methods and care with which the data are collected. Errors of the first group depend on the degree of permanency of channel and of permanency of the relation between discharge and stage.

[1] See Hoyt, J. C., and others, Use and care of current meter as practiced by the U. S. Geological Survey: Trans. Am. Soc. Civil Eng., vol. 66, 1910, p. 70.

Errors of the second class are due, first, to errors in observation of stage; second, to errors in measurements of flow, and, third, to errors due to misinterpretation of stage and flow data.

Practically all discharge measurements made under fair conditions are well within 5 per cent of the true discharge at the time of observation. Inasmuch as the errors of meter measurements are largely compensating, the mean rating curve, when well defined, is much more accurate than the individual measurements. Numerous experiments made to test the accuracy of current-meter work show that it compares very favorably with the results from standard weirs and, owing to simplicity of methods, usually gives results that are much more reliable than those from stations at dams, where the coefficient may be uncertain and conditions of flow are complicated.

The work is, of course, dependent on the reliability of the gage observers. With relatively few exceptions the observers perform their work honestly. The records are, however, closely watched, and the cause of any discrepancy is investigated. It is obvious that one gage reading a day does not always give the mean height for that day. As an almost invariable rule, however, errors from this source are compensating and virtually negligible in a period of one month, although a single day's reading may, when taken by itself, be considerably in error.

An effort is made to visit every station at least once each year for the purpose of making a measurement to determine the constancy of conditions of flow since the last measurement made in the preceding year, and also to check the elevation of the gage. On account of lack of funds or for other causes some stations were not visited during the current year. If conditions of flow have been reasonably permanent up to the time of the last preceding measurement, it is considered best to publish estimates of discharge based on the latest verified rating curve rather than to omit them altogether, although it should be distinctly understood that such records are at times subject to considerable error. This is also true, although to a less degree, of the period of records since the date of the last measurement of the current year. As a rule, the accuracy notes are based on the assumption that the rating curve used is strictly applicable to the current year.

In order to give engineers and others information regarding the probable accuracy of the computed results, footnotes are added to the daily discharge tables, stating the probable accuracy of the rating tables used, and an accuracy column is inserted in the monthly discharge table. For the rating tables "well defined" indicates, in general, that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined" or "approximate," within 15 to 25 per cent. These notes are very general and are based

on the plotting of the individual measurements with reference to the mean rating curve.

The accuracy column in the monthly discharge table does not apply to the maximum or minimum nor to any individual day, but to the monthly mean. It is based on the accuracy of the rating, the probable reliability of the observer, and knowledge of local conditions. In this column A indicates that the mean monthly flow is probably accurate within 5 per cent; B, within 10 per cent; C, within 15 per cent; D, within 25 per cent. Special conditions are covered by footnotes.

In general, the base data which are collected in the field each year by the Survey engineers are published, not only to comply with the law, but also for the express purpose of giving to any engineer the opportunity of examining the computed results and of changing and adjusting them as may seem best to him. Although it is believed that the rating tables and computed monthly discharges are as good as the base data up to and including the current year will warrant, it should always be borne in mind that the additional data collected at each station from year to year nearly always throw new light on data already collected and published, and hence allow more or less improvement in the computed results of earlier years. It is therefore expected that the engineer who makes serious use of the figures presented in these papers will verify all ratings and make such adjustments for earlier years as may seem necessary. The work of compiling, studying, revising, and republishing data for different drainage basins for 5 or 10 year periods or more is carried on by the United States Geological Survey so far as the funds for such work are available.

The estimates in the table of monthly discharge are so arranged as to give only a general idea of the conditions of flow at the station, and it is not expected that they will be used for other than preliminary estimates.

The daily discharges are published to allow a more detailed study of the variation in flow and to determine the periods of deficient flow.

COOPERATIVE DATA.

Cooperative data of various kinds and data regarding the run-off at many stations maintained wholly by private funds are incorporated in the surface water-supply reports of the United States Geological Survey.

Many stations throughout the country are maintained for specific purposes by private parties who supply the records gratuitously to the United States Geological Survey for publication. When such

records are furnished by responsible parties and appear to be reasonably accurate, they are verified, so far as possible, and estimated values of accuracy are given. Records clearly worthless or misleading are not published. As it is, however, impossible to completely verify all such records furnished—because of lack of funds or for other causes—they are published for what they are worth, as they are of value as a matter of record and afford at least approximate information regarding stream flow at the particular localities. The Survey does not, however, assume any responsibility for inaccuracies found in such records, although most of them are believed to be reasonably good.

COOPERATION AND ACKNOWLEDGMENTS.

Much of the work in Montana has been carried on under cooperative agreement with the United States Reclamation Service, the work being done by the Geological Survey and the expense borne by the Reclamation Service. The State engineer of Montana has a fund available for this work, which is expended in accordance with paragraph 3, section 2244 of the revised codes of 1907 of the State of Montana, which reads as follows:

> The State engineer shall become conversant with the waterways of the State and the needs of the State as to irrigation matters, shall make, or cause to be made, measurements and calculations of the ordinary and flood discharge of streams, cooperating in this work as much as possible with the United States Geological Survey and the Montana Experiment Station; such measurements to be made on streams in order of their importance, provided that measurements already made, if deemed reliable, may be adopted.

This fund has been expended chiefly for observers' salaries and field work on stations in connection with Carey projects. From July 1 to December 31, 1910, a State hydrographer was employed, whose salary and traveling expenses were paid from this fund and whose time was spent in stream-gaging work under the direction of the Geological Survey.

Since July, 1910, several stations have been maintained in the western part of the State in cooperation with the Forest Service; the gage observations being made by the forest rangers and occasional discharge measurements being made by the district engineer of the Forest Service.

Acknowledgments are due to the Great Northern and Northern Pacific railway companies for transportation furnished during the year.

The following tables show the amounts appropriated and expended for hydrographic work in the Missouri River basin in Montana in 1910, and the distribution of expenditures.

Statement of hydrographic work in the Missouri River drainage basin in Montana, calendar year 1910.

Appropriations:	
United States Geological Survey	$6,833.39
United States Reclamation Service	2,996.14
Total Government funds	9,829.53
State of Montana	2,036.00
Total expenditures for maintenance of river stations and allied investigations	11,865.53
Number of stations maintained	88
Number of stream gagings made	401
Cost per station	$134.84
Cost per gaging	$29.59
Distribution of expenditures:	
Field services	per cent.. 38
Office services	do.... 15
Traveling expenses	do.... 29
Supplies and equipment	do.... 7
Lost time (Sundays, holidays, etc.)	do.... 6
Rent and storage	do.... 2
General	do.... 3

Special acknowledgments are due to the following persons:

Mr. E. C. Simmons, State engineer of Nebraska, who spent over $500 on stream-gaging work under a cooperative contract with the United States Geological Survey.

Mr. C. W. Comstock, State engineer of Colorado, who paid the salaries of the gage observers and the expenses of the United States Geological Survey engineers, amounting to several hundred dollars. He also furnished a number of records, published in this paper, for stations which his office maintained independently of the United States Geological Survey.

Mr. George B. McFadden, an engineer representing a Denver company, who spent several hundred dollars in the maintenance of two stations on the Cache la Poudre in cooperation with the United States Geological Survey. He has contributed a number of valuable photographs taken on Cache la Poudre River, some of which are reproduced in this report.

The United States Reclamation Service, for the records on the North Platte at Pathfinder and Whalen, Wyo., and on the Belle Fourche at Belle Fourche, S. Dak.

The United States Forest Service, for gage observations furnished by its rangers and for other cooperative assistance.

Thanks are also due to the United States Weather Bureau, the Denver Union Water Co., the Denver Reservoir & Irrigation Co., and all other companies and persons who have rendered assistance and furnished records.

DIVISION OF WORK.

The work in the upper Missouri River drainage basin was under the direction of William A. Lamb, district engineer, assisted by Raymond Richards, M. E. McChristie, John C. Beebe, Benjamin E. Jones, junior engineers, and C. S. Heidel, State hydrographer.

The work in North Dakota was carried on by E. F. Chandler, assistant engineer.

The field data for the Missouri River drainage area in Colorado and Nebraska and the North Platte and Upper Bighorn basins in Wyoming were collected under the direction of W. B. Freeman, district engineer, assisted by G. H. Russell, H. D. Padgett, G. J. Lyon, S. T. Harding, E. O. Christiansen, and Arthur Dobson. The work in Nebraska was under the more immediate direction of Mr. E. C. Simmons, State engineer, and some of the stream-gaging work was done by his assistants.

The ratings and special estimates were made and the completed data prepared for publication by Raymond Richards and R. C. Rice. Computations have been made by G. C. Stevens, J. G. Mathers, J. J. Phelan, H. D. Padgett, and M. E. McChristie. The report has been edited by Mrs. B. D. Wood.

GAGING STATIONS MAINTAINED IN THE MISSOURI RIVER DRAINAGE BASIN.

The following list comprises the gaging stations maintained in the Missouri River drainage basin by the United States Geological Survey and cooperative parties. Data for these stations have been published in the reports listed on pages 3 to 5. The stations are arranged by river basins, in downstream order, tributaries of main streams being indicated by indention. (See p. 6.)

Red Rock River (head of Missouri) at Lima, Mont., 1907–1910.
Red Rock River at Red Rock, Mont., 1890.
Beaverhead River (continuation of Red Rock River) at Barratts, Mont., 1907–1910.
Beaverhead River at Dillon, Mont., 1907.
Jefferson River (continuation of Red Rock-Beaverhead River) near Sappington, Mont., 1896–1905.
Jefferson River near Silverstar, Mont., 1910.
Missouri River near Townsend, Mont., 1895–1904.
Missouri River at Canyon Ferry, Mont., 1889.
Missouri River near Craig, Mont., 1890–1902.
Missouri River at Cascade, Mont., 1902–1910.
Missouri River at Great Falls, Mont., 1897–1905.
Missouri River at Fort Benton, Mont., 1910.
Missouri River near Williston, N. Dak., 1905–1907.
Missouri River at Mannhaven, N. Dak., 1904.
Missouri River at Washburn, N. Dak., 1905.
Missouri River near Bismarck, N. Dak., 1904–5.

Missouri River at Kansas City, Mo., 1905–6.
Bighole River near Dewey, Mont., 1910.
Pipestone Creek near Whitehall, Mont., 1910.
Whitetail Creek near Whitehall, Mont., 1910.
Madison River near Red Bluff, Mont., 1890–1893.
Madison River near Norris, Mont., 1897–1905, 1910.
Madison River near Three Forks, Mont., 1895–1897.
West Gallatin River (head of Gallatin River) near Salesville, Mont., 1895–1905, 1910.
West Gallatin River near Bozeman, Mont., 1889–1893.
Gallatin River at Logan, Mont., 1895–1905.
Middle Creek near Bozeman, Mont., 1895–96, 1898–1900, 1901.
Crow Creek near Radersburg, Mont., 1903.
Prickly Pear Creek near Clancy, Mont., 1908–1910.
Prickly Pear Creek at East Helena, Mont., 1908–1910.
Lump Gulch Creek at Clancy, Mont., 1908–1910.
Tenmile Creek near Helena, Mont., 1908–1910.
Sevenmile Creek near Birdseye, Mont., 1908–1910.
Little Prickly Pear Creek near Marysville, Mont., 1909–10.
Little Prickly Pear Creek near Canyon Creek, Mont., 1909–10.
Deadman Creek near Marysville, Mont., 1909–10.
Lost Horse Creek near Marysville, Mont., 1909–10.
Marsh Creek near Marysville, Mont., 1909–10.
Dearborn River near Clemons, Mont., 1908–1910.
Falls Creek near Clemons, Mont., 1908–1910.
Smith River at Truly, Mont., 1905–1907.
Sun River (North Fork) near Augusta, Mont., 1889–90, 1903–1910.
Sun River at Sun River, Mont., 1905–1910.
Sun River near Great Falls, Mont., 1897.
Willow Creek near Augusta, Mont., 1910.
Sun River (South Fork) at Augusta, Mont., 1904–1910.
Ford Creek near Augusta, Mont., 1906–1910.
Smith Creek near Augusta, Mont., 1906–1910.
Belt Creek near Belt, Mont., 1905–6.
Highwood Creek near Highwood, Mont., 1905–6.
Marias River near Shelby, Mont., 1902–1907.
Two Medicine River near Midvale, Mont., 1902–3.
Two Medicine River at Family, Mont., 1907–1910.
Badger Creek near Family, Mont., 1907–1910.
Cutbank Creek at Cutbank, Mont., 1905–1910.
Birch Creek near Dupuyer, Mont., 1907–1910.
Dupuyer Creek at Dupuyer, Mont., 1908–1910.
Teton River at Chouteau, Mont., 1905–6.
Teton River near Belleview (Strabone) Mont., 1905–6, 1908–1910.
Judith River near Lewistown, Mont., 1910.
Musselshell River (North Fork) near Delpine, Mont., 1909–10.
Musselshell River (North Fork) near Martinsdale, Mont., 1907–1910.
Musselshell River at Harlowton, Mont., 1907–1910.
Musselshell River at Shawmut, Mont., 1902–1907.
Musselshell River at Lavina, Mont., 1906.
Checkerboard Creek near Delpine, Mont., 1909–10.
Musselshell River (South Fork) near Martinsburg, Mont., 1907–1910.
American Fork near Harlowton, Mont., 1907–1910.
Lebo Creek near Harlowton, Mont., 1907–1910.

Missouri River—Continued.
- Milk River (South Fork) near Browning, Mont., 1905–1910.
- Milk River at Havre, Mont., 1898–1910.
- Milk River at Chinook, Mont., 1897.
- Milk River at Malta, Mont., 1902–1910.
- Milk River at Hinsdale, Mont., 1908–9.
  - Milk River (West Fork) at Chinook, Mont., 1906–1908.
  - Milk River (North Fork) near Chinook, Mont., 1906–1910.
  - Beaver Creek near (Ashfield) Saco, Mont., 1903–1906, 1908–1910.
  - Beaver Creek overflow near Bowdoin, Mont., 1903–1906, 1908–1910.
  - Rock Creek near Hinsdale, Mont., 1905–1907.
  - Porcupine Creek near Nashua, Mont., 1908–1910.
  - Canals in the Milk River Basin—
    - Paradise Valley canal near Chinook, Mont., 1903–1909.
    - Cook canal near Chinook, Mont., 1905–1910.
    - Matheson canal near Chinook, Mont., 1905–6, 1908–1910.
    - Reser ditch near Chinook, Mont., 1905–6.
    - West Fork ditch near Chinook, Mont., 1905–6.
    - Harlem canal near Zurich, Mont., 1904–1906, 1908–1910.
    - Agency ditch near Harlem, Mont., 1905–1910.
    - Fort Belknap canal near Chinook, Mont., 1903–1910.
    - Winter Anderson canal near Chinook, Mont., 1906, 1908.
    - Rock Creek canal near Hinsdale, Mont., 1905–1907.
- Little Porcupine Creek near Frazer, Mont., 1908–1910.
- Wolf Creek at Wolf Point, Mont., 1908–1910.
- Wolf Point ditch at Wolf Point, Mont., 1909–10.
- Poplar Creek near Poplar, Mont., 1908–1910.
- Big Muddy River near Culbertson, Mont., 1908–1910.
- Yellowstone River at Corwin Springs, Mont., 1910.
- Yellowstone River near Horr, Mont., 1888–1893.
- Yellowstone River at Livingston, Mont., 1897–1905.
- Yellowstone River at Billings, Mont., 1904–5.
- Yellowstone River at Huntley, Mont., 1907–1910.
- Yellowstone River at Junction, Mont., 1906–7.
- Yellowstone River at Glendive, Mont., 1897–1910.
  - Big Timber Creek (North Fork) near Big Timber, Mont., 1907–1910.
  - Big Timber Creek (South Fork) near Big Timber, Mont., 1907–1910.
  - Boulder River near Contact, Mont., 1910.
    - Boulder River (East Fork) near McLeod, Mont., 1907–1909.
    - Boulder River (West Fork) near Bruffeys, Mont., 1907–1910.
    - Boulder River (West Fork) near McLeod, Mont., 1907–1910.
  - Sweetgrass Creek above Melville, Mont., 1907–1910.
  - Sweetgrass Creek below Melville, Mont., 1907–1910.
  - Stillwater River near Absarokee, Mont., 1910.
    - Rosebud River at Absarokee, Mont., 1910.
  - Clark Fork at Fromberg, Mont., 1906–1910.
  - Pryor Creek near Huntley, Mont., 1904–1910.
  - Big Wind River (head of Bighorn) near Wind River, Wyo., 1908–9.
  - Big Wind River near Riverton, Wyo., 1906–1908.
  - Bighorn River at Thermopolis, Wyo., 1900–1905, 1910.
  - Bighorn River near Hardin, Mont., 1904–1910.
    - Red Creek near Dubois, Wyo., 1909.
    - Dinwoody Creek near Crowheart, Wyo., 1909.
    - Dry Creek at Crowheart, Wyo., 1909.

Missouri River—Continued.
Yellowstone River—Continued.
Bighorn River—Continued.
Meadow Creek near J. K. ranch, Wyo., 1909.
Willow Creek at J. K. ranch, Wyo., 1909.
Bull Lake Creek near J. K. ranch, Wyo., 1909.
Little Wind River at Fort Washakie, Wyo., 1908–9.
Little Wind River above Arapahoe Agency, Wyo., 1906–1909.
Little Wind River below Arapahoe Agency, Wyo., 1906–1909.
Little Wind River (South Fork) near Wind River, Wyo., 1909.
St. Lawrence Creek near Wind River, Wyo., 1909.
Trout Creek at Wind River, Wyo., 1909.
Little Popo Agie River at Hudson, Wyo., 1907–1909.
Owl Creek near Thermopolis, Wyo., 1910.
No Wood River at Bonanza, Wyo., 1910.
Tensleep Creek near Tensleep, Wyo., 1910.
Paint Rock Creek near Bonanza, Wyo., 1910.
Greybull River near Meeteese, Wyo., 1897, 1903, 1910.
Wood River near Meeteese, Wyo., 1910.
Shoshone River at Cody, Wyo., 1902–1910.
Shoshone River at Corbett Dam, Wyo., 1908–1910.
Shoshone River near Lovell, Wyo., 1897–1899.
Shoshone River (South Fork) at Marquette, Wyo., 1903–1908.
Little Bighorn River at Crow Agency, Mont., 1905–6.
Prairie Dog ditch near Story, Wyo., 1903.
Tongue River near Dayton, Wyo., 1903.
Big Goose Creek near Sheridan, Wyo., 1895–1897.
Little Goose Creek near Sheridan, Wyo., 1896–97.
Powder River:
Clear Creek at Buffalo, Wyo., 1896–1904.
Piney Creek at Kearney, Wyo., 1902–1906.
Cruez ditch near Story, Wyo., 1903.
Little Muddy River near Williston, N. Dak., 1904–1909.
Little Missouri River at Alzada, Mont., 1904–1906.
Little Missouri River at Camp Crook, S. Dak., 1903–1906.
Little Missouri River at Medora, N. Dak., 1903–1908.
Knife River at (near) Broncho, N. Dak., 1903–1910.
Painted Woods Creek near Washburn, N. Dak., 1909–10.
Turtle Creek near Washburn, N. Dak., 1909–10.
Heart River near Richardton, N. Dak., 1903–1910.
Apple Creek near Bismarck, N. Dak., 1905.
Cannon Ball River at Stevenson, N. Dak., 1903–1909.
Grand River (North Fork) at Haley, N. Dak., 1908–1910.
Grand River near Seim, S. Dak., 1904–1906.
Owl (Moreau) River near Bixby, S. Dak., 1904–1906.
Cheyenne River at Edgemont, S. Dak., 1903–1906.
Beaver Creek near Edgemont, S. Dak., 1905–6.
Hat Creek near Edgemont, S. Dak., 1905–6.
Battle Creek near Hermosa, S. Dak., 1903.
Spring Creek near Rapid, S. Dak., 1903–1906.
Rapid Creek at Rapid, S. Dak., 1903–1906.
Box Elder Creek at Blackhawk, S. Dak., 1903–1905.
Corbin-Morse ditch at Rapid, S. Dak., 1906.

Missouri River—Continued.
Cheyenne River—Continued.
Elk Creek near Piedmont, S. Dak., 1903.
Belle Fourche River at Belle Fourche, S. Dak., 1903–1906.
Belle Fourche River near Belle Fourche, S. Dak., 1906.
Redwater River at Belle Fourche, S. Dak., 1903–1906.
Redwater River near Minnesela, S. Dak., 1903.
Redwater Canal at Minnesela, S. Dak., 1904–1906.
Spearfish Creek near Spearfish, S. Dak., 1903–1906.
Crow Creek near Belle Fourche, S. Dak., 1904.
Owl Creek near Belle Fourche, S. Dak., 1904.
Indian Creek near Belle Fourche, S. Dak., 1904.
White River at Interior, S. Dak., 1904–1906.
Niobrara River near Valentine (Fort Niobrara), Nebr., 1897, 1899, 1901–1906.
Niobrara River near Spencer, Nebr., 1908.
Niobrara River near Niobrara, Nebr., 1902, 1910.
Red Deer Lake (head of Plum Creek) near Woodlake, Nebr., 1904–5.
James River near Lamoure, N. Dak., 1903.
Big Sioux River near Watertown, S. Dak., 1900–1903.
Big Sioux River near Sioux Falls, S. Dak., 1900–1901.
Grizzly Creek at Hebron, Colo., 1904–5.
North Platte River (head of Platte River) near Hebron, Colo., 1904–5.
North Platte River near Cowdrey, Colo., 1904–5.
North Platte River near Pinkhampton, Colo., 1904.
North Platte River at Saratoga, Wyo., 1903–1906, 1909.
North Platte River at Pathfinder, Wyo., 1905–1910.
North Platte River at Alcova, Wyo., 1904–5.
North Platte River near Douglas, Wyo., 1894.
North Platte River near Orin Junction, Wyo., 1895–1900.
North Platte River near Fort Laramie, Wyo., 1887–1889.
North Platte River at Guernsey, Wyo., 1900–1908.
North Platte River at Whalen, Wyo., 1909.
North Platte River and Interstate canal at Whalen, Wyo., 1910.
North Platte River near Mitchell, Nebr., 1901–1910.
North Platte River near Gering, Nebr., 1897–1900.
North Platte River near Camp Clark, Nebr., 1896–1900.
North Platte River at Bridgeport, Nebr., 1902–1906.
North Platte River at North Platte, Nebr., 1894–1910.
Platte River near Lexington, Nebr., 1902–1906.
Platte River at Columbus, Nebr., 1895–1910.
Platte River near South Bend, Nebr., 1903.
Little Grizzly Creek at Hebron, Colo., 1904–5.
North Platte (Roaring Fork) near Hebron, Colo., 1904–5.
North Platte (North Fork) at Higho, Colo., 1904–5.
Michigan Creek near Walden, Colo., 1904–5.
Michigan Creek near Cowdrey, Colo., 1904–5.
Canadian River at Cowdrey, Colo., 1904–5.
Grand Encampment Creek near Peryam's ranch, Wyo., 1900.
Medicine Bow River near Medicine Bow, Wyo., 1901.
Sweetwater River near Splitrock, Wyo., 1902–3.
Laramie River at Glendevey, Colo., 1904–5, 1910.
Laramie River near Jelm, Wyo., 1904–5.
Laramie River near Woods Landing, Wyo., 1895–1900.

Missouri River—Continued.
Platte River—Continued.
Laramie River near Uva, Wyo., 1895–1900, 1903.
McIntyre Creek near Gleneyre, Colo., 1904–5.
Little Laramie River near Hatton, Wyo., 1902–3.
Little Laramie River near Laramie, Wyo., 1903.
South Platte (South Fork) near Cheesman Lake, Colo., 1899–1901.
South Platte (South Fork) at Fairplay, Colo., 1910.
South Platte (South Fork) at Lake George, Colo., 1910.
South Platte (South Fork) at South Platte, Colo., 1905–1910.
South Platte River at South Platte, Colo., 1902–1910.
South Platte River near Deansbury (Platte Canyon), Colo., 1887–1892, 1895–1900.
South Platte River at Denver, Colo., 1895–1906, 1909–10.
South Platte River near Kersey, Colo., 1901–1903, 1905–1910.
South Platte River near Orchard, Colo., 1895–1900.
South Platte River near Julesburg, Colo., 1902–1906, 1908–1910.
South Platte River near Big Spring, Nebr., 1902–3.
Tarryall Creek near Jefferson, Colo., 1910.
Tarryall Creek near Hayman, Colo., 1910.
Jefferson Creek near Jefferson, Colo., 1910.
Michigan Creek near Jefferson, Colo., 1910.
Goose Creek near Cheesman Lake, Colo., 1899.
South Platte River (North Fork) at Grant, Colo., 1910.
South Platte River (North Fork) at Cassells, Colo., 1908–1910.
South Platte River (North Fork) at South Platte, Colo., 1909–10.
Geneva Creek above Jackwhacker Creek, near Grant, Colo., 1909–10.
Geneva Creek at Old Geneva smelter, near Grant, Colo., 1909–10.
Geneva Creek at Sullivan's ranch, near Grant, Colo., 1908–1910.
Smelter Creek at Old Geneva smelter, near Grant, Colo., 1909–10.
Duck Lake Creek near Grant, Colo., 1909–10.
Scott Gomer Creek at Geneva Power Co's. dam site, Colo., 1909.
Scott Gomer Creek at Sullivan's ranch near Grant, Colo., 1909-10
Bear Creek near Morrison, Colo., 1888–1891, 1895–1902.
Clear Creek at Forkscreek, Colo., 1899–1910.
Clear Creek at Idaho Springs, Colo., 1910.
Clear Creek at Golden, Colo., 1897–98 and 1909.
St. Vrain Creek near Lyons, Colo., 1888–1892, 1895–1903, 1909.
Boulder Creek at Orodell, Colo., 1907–8, 1910.
Boulder Creek near Boulder, Colo., 1888–1892, 1895–1901, 1907–1909.
North Boulder Creek near Boulder, Colo., 1887–1890.
South Boulder Creek near Marshall, Colo., 1888–1892, 1895–1901, 1909.
Community canal near Marshall, Colo., 1909.
Big Thompson Creek near Arkins, Colo., 1888–1890, 1895–1903, 1909.
Big Thompson Creek near Loveland, Colo., 1888–1890.
Handy ditch near Arkins, Colo., 1899–1900, 1903.
Cache la Poudre River near Elkhorn, Colo., 1909–10.
Cache la Poudre River near Fort Collins, Colo., 1909–10.
Cache la Poudre River at mouth of canyon near Fort Collins, Colo., 1884-1901, 1910.
Cache la Poudre River near Greeley, Colo., 1903.
Middle Crow Creek near Hecla, Wyo., 1902–3.

Missouri River—Continued.
Platte River—Continued.
Loup River at Columbus, Nebr., 1894–1910.
Middle Loup River near St. Paul, Nebr., 1895, 1897, 1899, 1903.
North Loup River near St. Paul, Nebr., 1895, 1897, 1899, 1903.
Elkhorn River near Norfolk, Nebr., 1896–1903.
Elkhorn River near Arlington, Nebr., 1898–1903.
Elkhorn River (South Fork) near Norfolk, Nebr., 1896.
Republican River (North Fork) (head of Kansas River) near Benkleman, Nebr., 1895.
Republican River at Benkleman, Nebr., 1903–1906.
Republican River at Bostwick, Nebr., 1904–1910.
Republican River near Superior, Nebr., 1896–1903.
Republican River at Junction, Kans., 1895–1905.
Kansas River near St. George, Kans., 1904.
Kansas River near Topeka, Kans., 1904.
Kansas River near Lecompton, Kans., 1899–1901, 1903–1906.
Kansas River near Lawrence, Kans., 1895–1899.
Republican River (South Fork) at Benkleman, Nebr., 1895, 1903–1906.
Frenchman River near Wauneta, Nebr., 1895.
Frenchman River near Palisade, Nebr., 1895–96.
Smoky Hill River at Ellsworth, Kans., 1895–1902, 1904–5.
Smoky Hill River at Solomon, Kans., 1902–1904.
Beaver (Ladder) Creek near Scott City, Kans., 1904–5.
Saline River near Salina, Kans., 1895–1903.
Solomon River near Niles, Kans., 1895–1903.
Big Blue River (head of Blue River) at Beatrice, Nebr., 1910.
Blue River at Manhattan, Kans., 1895–1905.
Little Blue River near Fairbury, Nebr., 1908–1910.
Osage River at Ottawa, Kans., 1902–1905.
Gasconade River at Arlington, Mo., 1903–1906.
Gasconade River (Piney Fork) near Houston, Mo., 1908.
Gasconade River (Piney Fork) near Hooker, Mo., 1903. (Also called Big Piney Creek.)
Little Piney Creek near Arlington, Mo., 1903.

GENERAL FEATURES OF MISSOURI RIVER DRAINAGE BASIN.

Missouri River and its innumerable tributaries drain an immense area in the northern and western sections of the United States. The northern boundary of this area is approximately the fiftieth parallel, the southern the thirty-ninth; to the west it is limited by the Rocky Mountains; to the east the divide between it and the upper Mississippi basin crosses eastern North and South Dakota, western Iowa, and northeastern Missouri. Its extent east and west is about 900 miles; north and south it is 600 miles; and it comprises a total of 492,000 square miles.

The topography of the basin shows all gradations from the mountainous regions of Montana, Wyoming, and Colorado to the rolling prairies of the Dakotas, Nebraska, and Kansas. The upper tribu-

taries drain a forested region, but the main stream flows through a country almost wholly devoid of forests. The precipitation in the mountainous portion of the basin is mainly in the form of snow, but a great part of the area lies within the arid and semiarid regions and it is probable that the annual average precipitation throughout the entire basin is less than 20 inches.

The tributaries are chiefly in the upper course of the river and from the western side of the basin. The most important of these are Musselshell, Sun, Marias, Milk, Yellowstone, Cheyenne, Platte, and Kansas rivers.

Owing to the high altitude and northern climate ice prevails in the upper portions of this basin from November to April. The Missouri itself freezes over entirely, but many of its tributaries remain partly open on account of the extreme rapidity of the current. The amount of snow falling on the prairies is usually small, but among the mountains the snows begin early, continue late, and accumulate to great depths.

Irrigation is practiced to a great extent on the various tributaries of the Missouri and agriculture has been extensively developed in many of the valleys. The Madison and Gallatin and many other of the mountain tributaries afford unsurpassed storage facilities, the waters of the Beaverhead, Bighole, Madison, Jefferson, and Gallatin rivers furnish great supplies for irrigation, and the basins of Milk, Sun, Yellowstone, and Musselshell rivers, already extensively utilized, still offer opportunities for border irrigation, storage, and water-power development.

MISSOURI RIVER PROPER.

DESCRIPTION.

Missouri River proper is formed in southwestern Montana by the union of three streams, which were discovered by Lewis and Clark in 1806 and named by them Jefferson, Madison, and Gallatin rivers. Jefferson and Madison rivers come together first, and within 2 miles they are joined by the Gallatin. The head of the Missouri thus formed lies about in latitude 45° 56′ north and longitude 111° 32′ west. Each of the three headwater rivers is about 90 feet wide, flows with great velocity, and discharges large quantities of water. The Gallatin is the most rapid of the three, but the Jefferson drains the largest area, and is here treated as the continuation of the main river. The Jefferson itself is formed by the union of two forks—Bighole and Beaverhead rivers—the Beaverhead draining the larger area and having as its master headwater stream Red Rock River. The source of this last-named river—the Red Rock Lakes, lying in the Rocky Mountains 6,700 feet above sea level—may, therefore, be regarded as the ultimate source of the great Missouri.

Below the junction of the Jefferson, Madison, and Gallatin the course of the Missouri lies through mountain valleys and deep canyons, from which it finally emerges through a gorge in a range of rocks, called by Lewis and Clark the "gates of the Rocky Mountains." Thirty-five miles above Fort Benton the river pours over Great Falls, and from that point onward it is a navigable stream. For miles below the falls the river flows in a deep canyon, with banks ranging from 100 to 160 feet in height. Below the mouth of Marias River, which enters from the north, the banks are less abrupt and rise with gentle slopes to the bluffs. The high-water width of the river, which in the vicinity of Fort Benton is 500 to 1,000 feet, increases to 1,500 feet at the mouth of Milk River and to 2,000 feet near the mouth of the Yellowstone. Below the Yellowstone the width gradually increases from 2,000 to 3,000 feet, and this remains approximately the average width for 600 miles of its course.

From the mouth of the Yellowstone the Missouri follows a winding but on the whole southeasterly course until it is joined by the Kansas; thence it flows more to the east across the State of Missouri, and empties into the Mississippi 16 miles above St. Louis, 189 miles above the mouth of the Ohio, and 2,340 [1] miles below the junction of its three upper forks.

For the first 350 miles below the union of the three forks the Missouri is a comparatively clear stream, but approximately midway between the forks and the mouth of the Yellowstone its character gradually changes and it becomes turbid. Although a large amount of the sediment carried by the Missouri is undoubtedly brought in by the drainage of its tributaries, the greater part is derived from the caving of its banks.

Except in the mountain canyons the Missouri flows through an alluvial bottom land of the most fertile character, varying in width from 1½ miles near the mouth to 17 miles in the vicinity of Sioux City.

The volume of Missouri River is subject to great variations, the ordinary high-water discharge at the mouth being about 28 times the low-water discharge. The freshets are caused by melting snows and heavy summer rains. The regular floods occur in May, June, and July, the June discharge being the greatest. Thereafter the river steadily decreases in volume, the minimum being reached during the winter months. Records obtained at Cascade and Townsend indicate 1899 as the year of greatest flow and 1905 as the time of least flow.

The Missouri itself has not been used for irrigation owing to its high banks and consequent difficulty of diversion. Approximately 150,000 acres of land are now under irrigation in Beaverhead Valley,

[1] Given as 2,824 miles in Water-Supply Paper 246. This figure was taken from the report of the Tenth Census. More reliable information has since been published. See Water-Supply Paper 44, p. 70.

and by storing the waters of the upper Beaverhead or Red Rock River in Red Rock Lakes fully 125,000 acres more can be put under irrigation.

In Montana the Missouri, with its tributaries, affords many opportunities for power development. A number of large, substantial power-stations have been built, and approximately 75,000 horsepower is now being developed. Engineers estimate that 350,000 horsepower can be developed on the Missouri River near Great Falls.

RED ROCK RIVER AT LIMA, MONT.

This station, which was established August 14, 1907, to obtain data concerning the amount of water available for irrigation, is located near the Gleed ranch, 1 mile east of Lima.

The tributaries above the station are small and unimportant, the stream at the gaging station receiving its water supply chiefly from the melting snow in the mountains. Below the station Sheep and Sage creeks are the principal tributaries.

Diversions from this stream are many. Above the station three ditches, carrying approximately 900 miner's inches each, receive their water supply from the Red Rock. The water is all appropriated above the station but the rights are unadjudicated. The dam of the reservoir storing the water of the Red Rock has been completed, but no canals have been built. It is an earthen dam with concrete core, is 50 feet high, and has a capacity of 90,000 acre-feet. The dam is 16 miles above Lima, Mont., and 27 miles below lower Red Rock Lakes. Its top elevation is 6,700 feet. This water will be used to irrigate 25,000 acres of land near Lima.

On October 27, 1908, a new chain gage with a new datum was installed just above the cable, 300 feet farther downstream than the old staff gage which it replaces. The stream bed is permanent and the results obtained should be good. During the first six months of 1910 the gage height records are not as reliable as desired. A large spring enters the stream just above the gage and the river remains open the entire year. Measurements are made from a cable in ordinary and high-water stages, but in extreme low water measurements may be made by wading just below the cable section.

Discharge measurements of Red Rock River near Lima, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 2	Raymond Richards	36	44	1.08	92
July 8	W. A. Lamb	29	23	.98	42
Sept. 14	Raymond Richards	31	24	.94	52
Nov. 7	J. C. Beebe	38	69	1.45	104
Do.	do	36	69	1.42	100

Daily gage height, in feet, of Red Rock River at Lima, Mont., for 1910.

[Alice Gleed, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.2	1.0	1.1	1.7	3.8	2.3	1.0	1.1	1.6	3.8	1.5	1.2
2	1.15	1.05	1.1	1.95	3.7	2.3	1.0	1.2	1.2	3.6	1.5	1.2
3	1.1	1.05	1.1	1.95	3.7	2.25	1.6	1.2	1.2	3.6	1.5	1.2
4	1.1	1.0	1.1	2.6	3.7	2.2	1.7	1.3	.8	3.0	1.5	1.2
5	1.1	1.0	1.15	2.7	3.7	2.6	1.7	1.3	1.0	2.0	1.5	1.15
6	1.15	1.1	1.15	2.8	3.7	2.75	.9	1.3	.8	1.5	1.45	1.15
7	1.1	1.1	1.15	3.5	3.6	3.2	.9	1.4	.8	1.0	1.5	1.1
8	1.1	1.1	1.15	3.55	3.6	3.6	1.0	1.6	.8	1.0	1.55	1.1
9	1.1	1.05	1.15	3.6	3.6	3.75	1.05	1.5	.8	1.5	1.55	1.1
10	1.15	1.05	1.15	3.6	3.7	3.7	1.0	1.5	.8	1.5	1.55	1.1
11	1.15	1.05	1.15	4.1	3.6	3.75	1.0	1.5	.85	1.5	1.5	1.1
12	1.2	1.05	1.15	4.0	3.6	3.2	1.0	1.5	.85	1.5	1.5	1.1
13	1.1	1.1	1.2	4.0	3.6	3.1	1.0	1.5	.85	1.5	1.4	1.1
14	1.15	1.05	1.2	4.0	3.5	3.1	1.0	1.5	.85	1.5	1.4	1.1
15	1.2	1.05	1.2	4.1	3.5	3.2	1.05	1.5	1.0	1.5	1.4	1.1
16	1.1	1.05	1.2	4.2	3.2	3.0	1.05	1.45	1.8	1.5	1.4	1.1
17	1.1	1.05	1.2	4.0	3.0	3.0	1.15	1.35	1.8	1.5	1.4	1.1
18	1.15	1.05	1.2	4.0	2.7	3.0	1.15	1.4	2.4	1.5	1.45	1.1
19	1.15	1.05	1.2	4.2	2.7	3.0	1.25	1.45	2.6	1.5	1.4	1.1
20	1.1	1.05	1.2	4.0	2.4	2.9	1.15	1.45	2.6	1.5	1.4	1.1
21	1.1	1.05	1.2	3.8	2.1	2.8	1.15	1.4	2.8	1.5	1.45	1.1
22	1.1	1.05	1.2	4.0	2.0	2.8	1.0	1.4	2.8	1.5	1.45	1.0
23	1.1	1.05	1.2	4.1	2.0	2.7	1.0	1.45	2.8	1.5	1.45	1.0
24	1.1	1.1	1.2	4.0	2.1	2.0	1.0	1.5	2.8	1.55	1.45	1.0
25	1.1	1.1	1.2	3.9	2.1	1.5	1.0	1.4	2.9	1.5	1.5	1.0
26	1.15	1.1	1.2	3.8	2.15	1.3	1.0	1.3	2.9	1.5	1.5	1.0
27	1.1	1.1	1.2	3.95	2.15	1.2	1.0	1.3	3.2	1.5	1.4	1.05
28	1.1	1.1	1.2	3.95	2.2	1.0	1.05	1.4	3.3	1.55	1.3	1.0
29	1.1	.....	1.3	3.9	2.25	1.0	1.05	1.4	3.3	1.55	1.3	1.0
30	1.1	.....	1.5	3.9	2.3	.9	.9	1.5	3.3	1.5	1.2	1.0
31	1.1	.....	1.7	.....	2.5	.....	.95	1.6	.....	1.45	.....	1.0

Daily discharge, in second-feet, of Red Rock River at Lima, Mont., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	105	79	91	190	765	284	48	59	129	765	113	71
2	98	85	91	245	730	284	48	71	71	695	113	71
3	91	85	91	245	730	271	129	71	71	695	113	71
4	91	79	91	421	730	258	146	84	29	490	113	71
5	91	79	98	452	730	370	146	84	48	209	113	65
6	98	91	98	485	730	415	38	84	29	113	106	65
7	91	91	98	725	695	555	38	98	29	48	113	59
8	91	91	98	742	695	695	48	129	29	48	121	59
9	91	85	98	760	695	748	54	113	29	113	121	59
10	98	85	98	760	730	730	48	113	29	113	121	59
11	98	85	98	936	695	748	48	113	34	113	113	59
12	105	85	98	900	695	555	48	113	34	113	113	59
13	91	91	105	900	695	520	48	113	34	113	98	59
14	98	85	105	900	660	520	48	113	34	113	98	59
15	105	85	105	936	660	555	54	113	48	113	98	59
16	91	85	105	920	555	490	54	106	165	113	98	59
17	91	85	105	840	490	490	65	91	165	113	98	59
18	98	85	105	840	400	490	65	98	311	113	106	59
19	98	85	105	920	400	490	78	106	370	113	98	59
20	91	85	105	840	311	460	65	106	370	113	98	59
21	91	85	105	765	233	430	65	98	430	113	106	59
22	91	85	105	840	209	430	48	98	430	113	106	48
23	91	85	105	880	209	400	48	106	430	113	106	48
24	91	91	105	840	233	209	48	113	430	121	106	48
25	91	91	105	800	233	113	48	98	460	113	113	48
26	98	91	105	765	246	84	48	84	460	113	113	48
27	91	91	105	820	246	71	48	84	555	113	98	54
28	91	91	105	820	258	48	54	98	590	121	84	48
29	91	.....	120	800	271	48	54	98	590	121	84	48
30	91	.....	153	800	284	38	38	113	590	113	71	48
31	91	.....	190	.....	340	.....	43	129	.....	106	.....	48

NOTE.—These discharges are based on fairly well defined rating curves applicable as follows: Jan. 1 to Apr. 15, Apr. 16 to Dec. 31.

Monthly discharge of Red Rock River at Lima, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	105	91	94.2	5,790	B.
February	91	79	86.3	4,790	B.
March	190	91	106	6,520	B.
April	936	190	736	43,800	B.
May	765	209	502	30,900	B.
June	748	38	393	23,400	B.
July	146	38	59.9	3,680	B.
August	129	59	99.9	6,140	A.
September	590	29	234	13,900	A.
October	765	48	183	11,300	A.
November	121	71	105	6 250	A.
December	71	48	57.6	3,540	B.
The year	936	29	221	160,000	

NOTE.—Approximately 40,000 acre-feet of water were stored in the Red Rock reservoir in 1909 and released during the irrigating season of 1910.

BEAVERHEAD RIVER AT BARRATTS, MONT.

This station, which was established August 12, 1907, to obtain data for the solution of irrigation problems, is located 1 mile above Barratts and 10 miles southwest of Dillon, Mont.

This stream is called Red Rock River from its source in Red Rock Lakes to the post office of Red Rock, below which to its junction with Bighole River it is called the Beaverhead. The principal tributaries to the Beaverhead above the station are Grasshopper Creek, 12 miles south of Dillon; Horse Prairie Creek, 20 miles south, and Rattlesnake and Blacktail Deer creeks.

Irrigation has probably been practiced in Beaverhead Valley longer than in any other valley in Montana, ditches constructed in the early seventies being still in operation. Innumerable diversions are made. Decreed water rights aggregating 85,866 inches of water are filed on from Lima on Red Rock River to a point 10 miles above Twin Bridges. The three largest canals diverted below the gaging station are Canyon Creek canal, appropriating 6,000 inches; Union canal, appropriating 4,000, and the Beaverhead canal, diverted just north of Dillon, appropriating 5,000 inches. The Union Electric Co., of Dillon, has a canal with a carrying capacity of 6,000 inches.

An ordinary staff gage, fastened to the downstream side of the bridge, was used till June 22, 1908, when it was replaced by a standard chain gage. Measurements are made from the downstream side of the bridge.

The stream remains open during the winter months. The gaging section has a rocky bottom and should not shift. Records obtained are good.

It is worthy of note that the number and quantity of flow of springs in this valley have increased since irrigation began. The ground evidently serves as a reservoir, the water being absorbed as by a sponge and later coming to the surface as springs.

Discharge measurements of Beaverhead River at Barratts, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 3[a]	Raymond Richards	66	206	2.04	862
July 8[b]	W. A. Lamb	86	96	.70	179
Aug. 15[b]	J. C. Beebe	64	146	.82	304
Sept. 14[b]	Raymond Richards	72	84	.65	188
Nov. 7[a]	J. C. Beebe	60	142	1.20	406

[a] Made at bridge. [b] Made by wading below bridge.

Daily gage height, in feet, of Beaverhead River at Barratts, Mont., for 1910.

[W. A. Meeds, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.30	1.22	1.22	1.75	.....	1.45	.....	0.79	0.60	1.36	1.20	1.30
2	1.28	1.20	1.50	1.97	.....	1.36	.....	.78	.59	1.40	1.20	1.25
3	1.45	1.15	2.22	1.88	2.50	1.35	.....	.78	.55	1.44	1.20	1.26
4	1.50	1.18	3.55	1.92	2.58	1.30	.....	.78	.60	1.45	1.20	1.25
5	1.55	1.20	3.70	2.00	2.68	1.30	.....	.74	.59	1.24	1.20	1.21
6	1.50	1.24	2.35	2.05	2.90	1.30	.....	.74	.56	1.20	1.20	1.19
7	1.50	1.26	2.02	2.15	2.90	1.38	.....	.75	.58	1.12	1.20	1.15
8	1.25	1.10	1.94	2.25	2.60	1.48	0.70	.88	.58	1.09	1.32	1.12
9	1.28	1.15	1.85	2.35	2.72	1.49	.70	.85	.58	1.05	1.50	1.12
10	1.24	1.20	1.64	2.48	2.92	1.38	.70	.85	.58	1.05	1.30	1.20
11	1.11	1.19	1.70	2.68	2.98	1.25	.70	.85	.60	1.05	1.30	1.18
12	1.08	1.12	1.76	2.75	3.02	1.16	.70	.85	.60	1.04	1.30	1.15
13	1.10	1.15	1.91	2.78	2.92	1.11	.70	.85	.60	1.05	1.42	1.10
14	1.10	1.16	1.91	2.75	2.78	1.08	.71	.85	.64	1.05	1.48	1.15
15	1.16	1.10	1.97	2.62	2.72	1.05	.75	.85	.65	1.05	1.39	1.02
16	1.21	1.15	1.97	2.62	2.68	1.02	.75	.85	.68	1.05	1.32	1.16
17	1.25	1.18	2.00	2.60	2.58	1.00	.75	.85	.69	1.06	1.32	1.00
18	1.10	1.25	2.18	2.55	2.50	.90	.74	.86	.74	1.10	1.30	.99
19	1.22	1.16	2.50	2.55	2.35	.60	.70	.80	.82	1.10	1.25	1.00
20	1.22	1.18	2.80	2.60	2.26	.50	.70	.78	.89	1.06	1.20	1.00
21	1.26	1.26	2.92	2.78	2.19	.50	.74	.74	.98	1.06	1.35	1.00
22	1.30	1.20	3.00	2.82	1.90	.45	.80	.71	1.15	1.10	1.35	1.00
23	1.32	1.10	2.90	2.75	1.70	.42	.78	.70	1.28	1.10	1.34	1.02
24	1.35	1.18	2.48	2.70	1.59	.45	.75	.70	1.35	1.10	1.22	1.01
25	1.32	1.18	1.97	2.74	1.55	.51	.78	.68	1.40	1.10	1.30	1.04
26	1.25	1.10	1.90	2.74	1.69	.55	.78	.66	1.40	1.10	1.30	1.06
27	1.19	1.15	1.75	2.76	1.72	.51	.75	.64	1.40	1.10	1.30	1.12
28	1.20	1.15	1.70	2.76	2.05	.55	.76	.62	1.35	1.10	1.30	1.10
29	1.28	.....	1.62	2.78	1.95	.55	.78	.60	1.35	1.10	1.30	1.00
30	1.25	.....	1.60	2.80	1.72	.....	.78	.60	1.35	1.14	1.25	.99
31	1.30	.....	1.70	.....	1.55	.....	.79	.60	.....	1.19	.....	1.00

NOTE.—Gage stolen June 29. Replaced at same datum July 8.

Daily discharge, in second-feet, of Beaverhead River at Barratts, Mont., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	455	415	415	688	1,270	530	155	231	160	485	405	455
2	445	405	555	812	1,200	485	160	227	157	505	405	430
3	530	382	962	759	1,140	480	165	227	145	525	405	435
4	555	396	1,900	782	1,190	455	170	227	160	530	405	430
5	580	405	2,010	830	1,260	455	175	211	157	425	405	410
6	555	425	1,040	860	1,420	455	180	211	148	405	405	400
7	555	435	842	920	1,420	495	185	215	154	369	405	382
8	430	360	794	980	1,200	545	195	267	154	356	465	369
9	445	382	742	1,040	1,290	550	195	255	154	338	555	369
10	425	405	627	1,130	1,430	495	195	255	154	338	455	405
11	364	400	660	1,260	1,480	430	195	255	160	338	455	396
12	351	369	693	1,310	1,500	387	195	255	160	333	455	382
13	360	382	776	1,330	1,430	364	195	255	160	338	515	360
14	360	387	776	1,310	1,300	351	199	255	174	338	545	382
15	387	360	812	1,220	1,290	338	215	255	178	338	500	324
16	410	382	812	1,220	1,260	324	215	255	188	338	465	387
17	430	396	830	1,200	1,190	315	215	255	192	342	465	315
18	360	430	938	1,170	1,140	275	211	259	215	360	455	311
19	415	387	1,140	1,170	1,040	160	195	235	243	360	430	315
20	415	396	1,340	1,200	986	130	195	227	271	342	405	315
21	435	435	1,430	1,340	944	130	211	211	307	342	480	315
22	455	405	1,490	1,360	770	120	235	199	382	360	480	315
23	465	360	1,420	1,310	660	114	227	195	445	360	475	324
24	480	396	1,130	1,280	600	120	215	195	480	360	415	320
25	465	396	812	1,300	580	133	227	188	505	360	455	333
26	430	360	770	1,300	654	145	227	181	505	360	455	342
27	400	382	688	1,320	671	133	215	174	505	360	455	369
28	405	382	660	1,320	860	145	219	167	480	360	455	360
29	445	.....	616	1,340	800	145	227	160	480	360	455	315
30	430	.....	605	1,340	671	150	227	160	480	378	430	311
31	455	.....	660	.....	580	.....	231	160	.....	400	.....	315

NOTE.—These discharges are based on a rating curve that is fairly well defined between 130 and 1,140 second-feet. Discharges interpolated for days on which gage heights were not recorded.

Monthly discharge of Beaverhead River at Barratts, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	580	351	442	27,200	B.
February	435	360	393	21,800	B.
March	2,010	415	934	57,400	A.
April	1,360	688	1,150	68,400	A.
May	1,500	580	1,070	65,800	A.
June	550	114	304	18,100	A.
July	235	155	202	12,400	B.
August	267	160	220	13,500	B.
September	505	145	268	15,900	B.
October	530	338	378	23,200	A.
November	555	405	452	26,900	A.
December	455	311	361	22,200	A.
The year	2,010	114	515	373,000	

JEFFERSON RIVER NEAR SILVERSTAR, MONT.

This station, which was established August 11, 1910, is located a few miles below the junction of Bighole and Beaverhead rivers, on the big highway bridge on the road from Iron Rod to Silverstar about 1 mile from Iron Rod station on a branch of the Northern Pacific Railway, 18 miles from Whitehall and 8 miles from Twin Bridges. The principal tributaries below the station are Pipestone and Whitetail creeks.

A standard staff gage is fastened to outer pier on the downstream side of the bridge from which discharge measurements are made.

Irrigation is carried on extensively from the headwaters of this stream to its mouth.

Discharge measurements of Jefferson River near Silverstar, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 11	Raymond Richards	152	289	1.80	353
Nov. 6	J. C. Beebe	200	515	2.78	1,180

Daily gage height, in feet, and discharge, in second-feet, of Jefferson River near Silverstar, Mont., for 1910.

[C. A. Barkell, observer.]

Day.	Aug.		Sept.		Oct.		Nov.		Dec.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			1.85	368	2.55	865	2.80	1,210	2.97	1,490
2			1.90	385	2.50	805	2.80	1,210	3.00	1,540
3			1.95	405	2.55	865	2.85	1,290	3.10	1,720
4			1.95	405	2.60	925	2.85	1,290	3.00	1,540
5			2.00	425	2.65	993	2.80	1,210	3.00	1,540
6			2.00	425	2.60	925	2.80	1,210	2.90	1,370
7			2.00	425	2.55	865	2.80	1,210	2.90	1,370
8			2.00	425	2.55	865	2.80	1,210	2.80	1,210
9			2.05	450	2.55	865	2.84	1,270	2.80	1,210
10			2.10	475	2.60	925	2.86	1,310	2.80	1,210
11	1.80	350	2.10	475	2.60	925	2.92	1,400	2.80	1,210
12	1.80	350	2.15	505	2.65	993	2.94	1,440	2.86	1,310
13	1.85	368	2.15	505	2.65	993	2.96	1,470	2.86	1,310
14	1.90	385	2.10	475	2.65	993	3.00	1,540	2.90	1,370
15	1.90	385	2.10	475	2.60	925	3.00	1,540	2.90	1,370
16	1.90	385	2.10	475	2.60	925	3.10	1,720	2.90	1,370
17	1.90	385	2.05	450	2.65	993	3.20	1,910	2.90	1,370
18	1.90	385	2.05	450	2.65	993	3.10	1,720	2.90	1,370
19	1.85	368	2.10	475	2.60	925	3.10	1,720	2.96	1,470
20	1.85	368	2.20	535	2.60	925	3.00	1,540	2.94	1,440
21	1.75	335	2.60	925	2.65	993	3.00	1,540	2.90	1,370
22	1.70	320	2.40	700	2.65	993	3.00	1,540	2.88	1,340
23	1.75	335	2.30	610	2.65	993	2.90	1,370	2.86	1,320
24	1.75	335	2.30	610	2.65	993	2.90	1,370	2.88	1,340
25	1.75	335	2.50	805	2.70	1,060	2.96	1,470	2.80	1,210
26	1.80	350	2.60	925	2.75	1,140	2.98	1,510	2.86	1,310
27	1.80	350	2.55	865	2.75	1,140	3.00	1,540	2.90	1,370
28	1.80	350	2.55	865	2.70	1,060	3.00	1,540	2.90	1,370
29	1.85	368	2.60	925	2.70	1,060	2.95	1,460	2.90	1,370
30	1.85	368	2.60	925	2.75	1,140	2.90	1,370	2.90	1,370
31	1.85	368			2.75	1,140			2.90	1,370

NOTE.—These discharges are based on a rating curve fairly well defined between 340 and 2,800 second-feet.

Monthly discharge of Jefferson River near Silverstar, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
Aug. 11–31	385	320	359	15,000	B.
September	925	368	572	34,000	B.
October	1,140	805	974	59,900	A.
November	1,910	1,210	1,440	85,700	A.
December	1,720	1,210	1,370	84,200	A.

MISSOURI RIVER AT TOSTON, MONT.

A station was established on the Missouri River at the highway bridge at Toston, Mont., on April 5, 1910. Gallatin, Jefferson, and Madison rivers unite about 25 miles above the station. Sixteenmile Creek is the only tributary of importance between the station and the headwaters. Between Toston and the station at Cascade, Prickly Pear and Little Prickly Pear creeks and Dearborn River enter the Missouri.

A standard chain gage is fastened to the downstream side of the public highway bridge. Measurements are made from a newly constructed cable equipment just above the bridge. Excellent results can be obtained. The discharge is affected by ice only in extremely cold weather.

Discharge measurements of Missouri River at Toston, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 15	W. A. Lamb	448	1,740	4.50	6,390
May 6	do	450	2,260	5.75	10,500
June 2	do	445	2,530	6.19	13,300
Do.	M. E. McChristie	455	2,520	6.19	13,600
July 7	J. C. Beebe	397	1,180	3.30	2,420
22	M. E. McChristie	384	1,140	3.20	2,340
Aug. 13	B. E. Jones	374	1,030	2.95	1,860
Do.	W. A. Lamb	407	1,010	2.95	1,820
Nov. 5	B. E. Jones	455	1,360	3.71	4,030
Dec. 7	W. A. Lamb	453	1,330	3.75	3,700
Do.	B. E. Jones	455	1,330	3.75	[a] 3,520

[a] Meter affected by ice; results low.

Daily gage height, in feet, of Missouri River at Toston, Mont., for 1910.

[W. B. Lorentz, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.60	6.10	3.35	2.80	3.00	3.55	3.65	3.68
2	.....	6.50	6.00	3.35	2.90	3.02	3.48	3.60	3.68
3	.....	6.20	5.95	3.40	2.90	2.97	3.45	3.65	3.75
4	.....	5.90	5.65	3.40	3.25	3.05	3.75	3.75	3.78
5	4.50	5.75	5.55	3.35	2.95	3.10	3.80	3.65	3.82
6	4.40	5.70	5.30	3.40	2.95	3.15	3.75	3.70	3.68
7	4.40	5.75	5.25	3.25	2.95	3.20	3.73	3.68	3.75
8	4.50	5.90	5.05	3.35	2.80	3.32	3.65	.....	3.75
9	4.65	6.00	4.95	3.35	2.90	3.20	3.50	3.62	3.75
10	4.95	6.20	5.00	3.25	2.85	3.27	3.60	3.68	3.66

Daily gage height, in feet, of Missouri River at Toston, Mont., for 1910—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	5.05	6.65	5.00	3.20	2.95	3.27	3.52	3.75	3.60
12	5.20	7.10	4.90	3.15	3.00	3.30	3.52	3.75	3.58
13	5.50	7.05	4.80	3.20	2.95	3.27	3.52	3.80	3.60
14	5.50	6.90	4.70	3.30	2.95	3.25	3.60	3.98	3.62
15	5.35	6.80	4.60	3.35	2.90	3.23	3.75	3.95	3.62
16	5.05	6.65	4.40	3.25	2.90	3.22	3.70	3.95	3.62
17	5.00	6.55	4.15	3.30	2.95	3.25	3.50	3.87	3.42
18	5.00	6.35	4.20	3.30	2.90	3.25	3.50	3.85	3.35
19	5.00	6.10	4.20	3.30	2.95	3.25	3.65	3.70	3.50
20	5.05	6.00	4.10	3.25	2.90	3.38	3.72	3.78	3.40
21	5.15	5.85	3.95	3.30	2.87	3.50	3.73	3.75	3.35
22	5.30	5.50	3.85	3.10	2.88	3.53	3.68	3.82	3.40
23	5.35	5.45	3.70	2.90	2.67	3.43	3.65	3.82	3.40
24	5.45	5.40	3.60	2.95	2.95	3.50	3.68	3.85	3.35
25	5.55	5.55	3.45	2.85	2.95	3.58	3.68	3.80	3.50
26	5.65	5.75	3.60	2.85	2.95	3.55	3.67	3.88	3.42
27	5.85	5.85	3.50	2.75	2.85	3.63	3.66	3.70	3.30
28	6.20	6.05	3.50	2.85	2.95	3.63	3.63	3.62	3.40
29	6.60	6.10	3.40	2.85	2.90	3.60	3.75	3.65	3.40
30	6.75	6.15	3.35	2.85	2.90	3.65	3.78	3.68	3.38
31	.....	6.20	.....	2.90	3.00	.....	3.67	.....	3.40

Daily discharge, in second-feet, of Missouri River at Toston, Mont., for 1910.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	15,400	13,100	2,720	1,560	1,920	3,240	3,520	3,600
2	.....	14,900	12,600	2,720	1,730	1,960	3,060	3,380	3,660
3	.....	13,500	12,400	2,850	1,730	1,860	2,980	3,520	3,800
4	.....	12,200	11,100	2,850	2,480	2,020	3,800	3,800	3,800
5	6,310	11,500	10,600	2,720	1,820	2,130	3,950	3,520	4,010
6	5,940	11,300	9,560	2,850	1,820	2,240	3,800	3,660	3,600
7	5,940	11,500	9,340	2,480	1,820	2,360	3,750	3,660	3,800
8	6,310	12,200	8,500	2,720	1,560	2,650	3,520	[a]3,550	3,800
9	6,880	12,600	8,090	2,720	1,730	2,360	3,110	3,440	3,800
10	8,100	13,500	8,300	2,480	1,640	2,530	3,380	3,600	3,380
11	8,500	15,600	8,300	2,360	1,820	2,530	3,160	3,800	3,380
12	9,130	17,800	7,890	2,240	1,920	2,600	3,160	3,800	3,330
13	10,400	17,500	7,480	2,360	1,820	2,530	3,160	3,950	3,380
14	10,400	16,800	7,080	2,600	1,820	2,480	3,380	4,500	3,440
15	9,780	16,400	6,690	2,720	1,730	2,430	3,800	4,400	3,440
16	8,500	15,600	5,940	2,480	1,730	2,410	3,660	4,400	3,440
17	8,300	15,200	5,060	2,600	1,820	2,480	3,110	4,160	2,960
18	8,300	14,200	5,230	2,600	1,730	2,480	3,110	4,100	2,980
19	8,300	13,100	5,230	2,600	1,820	2,480	3,520	3,660	3,110
20	8,500	12,600	4,890	2,480	1,730	2,800	3,720	3,890	2,850
21	8,920	11,900	4,410	2,600	1,680	3,110	3,750	3,800	2,720
22	9,560	10,400	4,100	2,130	1,700	3,190	3,600	4,010	2,850
23	9,780	10,200	3,660	1,730	1,370	2,930	3,520	4,010	2,850
24	10,200	9,990	3,380	1,820	1,820	3,110	3,600	4,100	2,720
25	10,600	10,600	2,980	1,640	1,820	3,330	3,600	3,950	3,110
26	11,100	11,500	3,380	1,640	1,820	3,240	3,580	4,190	2,900
27	11,900	11,900	3,110	1,480	1,640	3,460	3,550	3,660	2,600
28	13,500	12,800	3,110	1,640	1,820	3,460	3,460	3,440	2,850
29	15,400	13,100	2,850	1,640	1,730	3,380	3,800	3,520	2,850
30	16,100	13,300	2,720	1,640	1,730	3,520	3,890	3,660	2,800
31	.....	13,500	.....	1,730	1,920	.....	3,580	.....	2,850

[a] Interpolated.

NOTE.—These discharges are based on a well-defined rating curve.

Monthly discharge of Missouri River at Toston, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
Apr. 5–30	16,100	5,940	9,490	489,000	A.
May	17,800	9,990	13,300	818,000	A.
June	13,100	2,720	6,700	399,000	A.
July	2,850	1,480	2,320	143,000	A.
August	2,480	1,370	1,770	109,000	A.
September	3,320	1,860	2,670	159,000	A.
October	3,950	2,980	3,490	215,000	A.
November	4,500	3,380	3,820	227,000	A.
December	4,010	2,720	3,140	193,000	A.
The period				2,750,000	

MISSOURI RIVER AT CASCADE, MONT.

This station, which was established July 20, 1902, to obtain records for use in connection with irrigation and power development, is located on the highway bridge on the east side of the town of Cascade, Mont., 100 yards from the Great Northern Railway.

The Missouri receives many tributaries above the station, the most important being Dearborn River, Little Prickly Pear Creek, and Prickly Pear Creek; within 100 miles below the station Sun and Marias rivers enter. The drainage area at the station is 18,300 square miles.

Although irrigation is extensively developed in the Missouri River Valley the water is taken from the tributary streams, the Missouri itself, because of its high banks, great variation in flow, and difficulty of diversion, being little used.

The datum of the standard chain gage on the bridge used at this station has remained unchanged. All measurements are made from the lower side of the bridge.

Records obtained have been very good, the channel being permanent except in extreme floods. Gage heights are affected by ice during the winter months.

Discharge measurements of Missouri River at Cascade, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 28	Raymond Richards	470	1,900	(a)	4,050
July 8	J. C. Beebe	354	2,700	4.36	3,270
23	R. H. Bolster	356	2,820	4.05	2,500
Aug. 9	M. E. McChristie	349	2,420	3.61	1,630
Sept. 22	B. E. Jones	359	2,850	4.80	4,420
Nov. 25	C. S. Herdel	360	2,930	a 5.21	5,070

a Discharge affected by ice.

Daily gage height, in feet, of Missouri River at Cascade, Mont., for 1910.

[Wm. W. Doan, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.6	4.6	5.5	6.4	8.2	8.0	4.5	3.9	3.82	4.5	4.5	4.9
2	4.6	4.6	6.05	6.4	8.05	7.9	4.5	3.9	3.85	4.4	4.7	4.9
3	4.6	4.6	7.25	6.4	7.85	7.7	4.4	3.9	3.7	4.7	4.6	5.0
4	4.6	4.6	8.1	6.5	7.55	7.3	4.4	3.8	3.65	4.95	4.7	5.1
5	4.6	4.6	10.25	6.5	7.5	7.0	4.4	3.8	3.65	4.6	4.7	5.1
6	4.6	4.6	10.7	6.6	7.4	7.0	4.4	3.7	3.7	4.6	4.7	5.1
7	4.6	4.6	9.3	6.6	7.5	7.1	4.3	3.6	3.95	4.5	4.7	5.0
8	4.6	4.6	7.7	6.6	7.8	7.2	4.3	3.5	4.22	4.5	4.7	5.0
9	4.5	4.6	6.8	6.6	8.05	7.3	4.3	3.6	4.22	4.5	4.8	5.1
10	4.5	4.6	6.7	6.6	8.25	7.1	4.3	3.6	4.3	4.5	4.9	5.1
11	4.5	4.6	6.5	6.6	8.45	6.7	4.4	3.7	4.38	4.4	5.1	5.1
12	4.5	4.6	6.1	6.7	8.7	6.45	4.4	3.7	4.3	4.4	5.1	5.0
13	4.5	4.6	5.85	6.8	8.9	6.2	4.4	3.6	4.4	4.4	4.9	5.0
14	4.5	4.6	5.7	6.95	8.9	6.1	4.3	3.6	4.3	4.5	4.9	5.0
15	4.6	4.6	5.7	7.0	8.8	6.0	4.2	3.6	4.4	4.4	5.0	4.9
16	4.6	4.6	5.7	6.9	8.65	6.0	4.1	3.6	4.4	4.5	5.1	4.8
17	4.6	4.6	5.7	6.9	8.45	5.9	4.15	3.7	4.4	4.5	5.0	4.7
18	4.6	4.6	5.85	6.9	8.3	5.8	4.15	3.7	4.4	4.8	5.0	4.8
19	4.6	4.6	6.05	6.95	8.0	5.7	4.1	3.8	4.8	4.9	5.0	4.8
20	4.6	4.6	6.15	7.0	8.1	5.6	4.1	3.68	4.4	4.7	5.0	4.8
21	4.6	4.7	6.2	7.0	8.0	5.45	4.1	3.72	4.6	4.5	5.0	4.9
22	4.6	4.7	6.2	7.0	7.85	5.25	4.0	3.75	4.7	4.5	5.0	4.9
23	4.6	4.7	6.35	7.0	7.75	5.15	4.0	3.75	4.6	4.9	5.0	4.9
24	4.6	4.8	6.6	7.0	7.5	5.0	4.0	3.62	4.6	4.9	5.1	4.9
25	4.6	4.8	6.85	7.15	7.1	4.9	4.0	3.65	4.7	4.7	5.1	5.0
26	4.6	5.0	6.9	7.2	7.35	4.75	4.0	3.64	4.6	4.9	5.1	5.0
27	4.6	5.1	6.9	7.2	7.6	4.6	3.9	3.64	4.2	5.0	5.1	5.0
28	4.6	5.2	6.9	7.25	7.6	4.6	3.95	3.65	4.1	5.1	5.1	6.0
29	4.6	.....	6.85	7.35	7.7	4.5	4.1	3.60	4.1	4.9	5.1	6.1
30	4.6	.....	6.65	7.95	7.8	4.5	4.0	3.68	4.0	4.6	5.1	6.1
31	4.6	.....	6.4	.....	7.9	.....	3.9	3.72	.....	4.5	.....	6.1

NOTE.—Gage heights distorted by ice Jan. 1 to Mar. 10 and Dec. 26 to 31.

Daily discharge, in second-feet, of Missouri River at Cascade, Mont., for 1910.

[Wm. W. Doan, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	4,500	9,790	16,800	16,000	3,600	2,160	2,010	3,600	3,600	3,740
2	.....	.....	6,000	9,790	16,200	15,500	3,600	2,160	2,060	3,340	4,150	3,740
3	.....	.....	9,000	9,790	15,300	14,700	3,340	2,160	1,800	4,150	3,870	5,040
4	.....	.....	10,000	10,200	14,100	13,100	3,340	1,970	1,720	3,890	4,150	5,350
5	.....	.....	10,000	10,200	13,900	12,000	3,340	1,970	1,720	3,870	4,150	5,350
6	.....	.....	10,000	10,500	13,500	12,000	3,340	1,800	1,800	3,870	4,150	5,350
7	.....	.....	10,000	10,500	13,900	12,400	3,090	1,650	2,260	3,600	4,150	5,040
8	.....	.....	11,000	10,500	15,100	12,700	3,090	1,520	2,890	3,600	4,150	5,040
9	.....	.....	11,000	10,500	16,200	13,100	3,090	1,650	2,890	3,600	4,440	5,350
10	.....	.....	10,600	10,500	17,000	12,400	3,090	1,650	3,090	3,600	3,740	5,350
11	.....	.....	10,200	10,500	17,800	10,900	3,340	1,800	3,290	3,340	5,350	5,350
12	.....	.....	8,710	10,900	18,900	9,970	3,340	1,800	3,090	3,340	5,350	5,040
13	.....	.....	7,840	11,300	19,700	9,070	3,340	1,650	3,340	3,340	3,740	5,040
14	.....	.....	7,320	11,800	19,700	8,710	3,090	1,650	3,090	3,600	3,740	5,040
15	.....	.....	7,320	12,000	19,300	8,360	2,840	1,650	3,340	3,340	5,040	3,740
16	.....	.....	7,320	11,600	18,700	8,360	2,600	1,650	3,340	3,600	5,350	4,440
17	.....	.....	7,320	11,600	17,800	8,010	2,720	1,800	3,340	3,600	5,040	4,150
18	.....	.....	7,840	11,600	17,200	7,660	2,720	1,800	3,340	4,440	5,040	4,440
19	.....	.....	8,540	11,800	16,000	7,320	2,600	1,970	4,440	3,740	5,040	4,440
20	.....	.....	8,890	12,000	16,400	6,980	2,600	1,770	3,340	4,150	5,040	4,440
21	.....	.....	9,070	12,000	16,000	6,480	2,600	1,830	3,870	3,600	5,040	3,740
22	.....	.....	9,070	12,000	15,300	5,830	2,370	1,880	4,150	3,600	5,040	3,740
23	.....	.....	9,610	12,000	14,900	5,510	2,370	1,880	3,870	3,740	5,040	3,740
24	.....	.....	10,500	12,000	13,900	5,040	2,370	1,680	3,870	3,740	5,350	3,740
25	.....	.....	11,400	12,600	12,400	3,740	2,370	1,720	4,150	4,150	5,350	5,040
26	.....	.....	11,600	12,700	13,300	4,300	2,370	1,710	3,870	3,740	5,350	5,040
27	.....	.....	11,600	12,700	14,300	3,870	2,160	1,710	2,840	5,040	5,350	5,040
28	.....	.....	11,600	12,900	14,300	3,870	2,260	1,720	2,600	5,350	5,350	5,040
29	.....	.....	11,400	13,300	14,700	3,600	2,600	1,650	2,600	3,740	5,350	5,040
30	.....	.....	10,700	15,800	15,100	3,600	2,370	1,770	2,370	3,870	5,350	5,040
31	.....	.....	9,790	.....	15,500	.....	2,160	1,830	.....	3,600	.....	5,040

NOTE.—These discharges are based on a fairly well defined curve. Discharges Mar. 1 to 10 and Dec. 26 to 31 estimated.

Monthly discharge of Missouri River at Cascade, Mont., for 1910.

[Drainage area, 18,300 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January			[a] 3,400	0.186	0.21	209,000	D.
February			[a] 3,450	.188	.20	192,000	D.
March			[a] 9,480	.518	.60	583,000	C.
April	15,800	9,790	11,500	.628	.70	684,000	B.
May	19,700	12,400	15,900	.869	1.00	978,000	B.
June	16,000	3,600	8,840	.483	.54	526,000	B.
July	3,600	2,160	2,840	.155	.18	175,000	B.
August	2,160	1,520	1,800	.098	.11	111,000	B.
September	4,440	1,720	3,010	.164	.18	179,000	B.
October	5,350	3,340	3,800	.208	.24	234,000	B.
November	5,350	3,600	4,730	.258	.29	281,000	B.
December	5,350	3,740	4,700	.257	.30	289,000	C.
The year			6,120	.334	4.55	4,440,000	

[a] Estimated from records obtained at Canyon Ferry Dam.

MISSOURI RIVER AT FORT BENTON, MONT.

This station was established by the United States Weather Bureau on July 1, 1902, and gage-height readings have been obtained since that date. On April 28, 1910, a regular gaging station was established by the United States Geological Survey and partial estimates of run-off have been obtained for the year 1910. A Mott tape-and-weight gage was installed April 11, 1907, on the upstream side of the public highway bridge at Fort Benton. The gage datum has remained constant since that date. Current-meter measurements are made from the downstream side of the bridge.

Many tributaries enter Missouri River above the station. The drainage area at Fort Benton embraces 112,000 square miles.

Discharge measurements of Missouri River at Fort Benton, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 28	W. A. Lamb	553	3,540	4.40	17,100
May 23	M. E. McChristie	554	3,690	4.62	19,400
30	do	554	3,690	4.52	18,800
July 16	do	411	1,800	.88	4,070
24	do	422	1,610	.63	3,250
Aug. 10	do	377	1,460	.25	2,380
16	do	389	1,500	.35	2,550
Sept. 21	B. E. Jones	452	1,870	1.12	4,750

Daily gage height, in feet, and discharge, in second-feet, of Missouri River at Fort Benton, Mont., for 1910.

[Guy Quick, observer.]

Day.	Aug.		Sept.		Oct.		Nov.		Dec.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			0.58	3,160	0.82	3,830	1.31	5,400		
2			.58	3,160	.96	4,260	1.12	4,770	1.29	5,340
3			.66	3,370	1.12	4,770	1.14	4,830	1.30	5,370
4			.62	3,260		4,800	1.16	4,900	1.30	5,370
5			.48	2,910		4,800	1.27	5,270	1.28	5,300
6			.52	3,010		4,800	1.19	5,000	1.28	5,300
7			.46	2,780		4,900	1.32	5,440	1.00	4,380
8			.55	3,080		4 900	1.32	5,440	1.30	5,370
9			.81	3,800		4,950	1.43	5,820	1.30	5,370
10			.90	4,070	1.20	5,030	1.41	5,740	1.30	5,370
11			.96	4,260	1.20	5,030			1.40	5,710
12			1.00	4,380	1.12	4,770			1.40	5,710
13			1.06	4,570	1.16	4,900			1.30	5,370
14			1.04	4,510	1.14	4,830			1.30	5,370
15			1.05	4,540	1.12	4,770			1.20	5,030
16			1.05	4,540	1.16	4,900			1.15	4,860
17	0.30	2,520	1.02	4,440	1.19	5,000			1.10	4,700
18	.35	2,620	1.04	4,510	1.20	5,030			1.10	4,700
19	.38	2,690	1.10	4,700	1.31	5,400			1.10	4,700
20	.39	2,710	1.31	5,400	1.44	5,850			1.00	4,380
21	.30	2,520	1.20	5,030	1.42	5,780			1.00	4,380
22	.39	2,710	1.14	4,830	1.39	5,680			1.00	4,380
23	.36	2,650	1.24	5,170	1.12	4,770			.90	4,070
24	.42	2,780	1.25	5,200	1.26	5,240			.90	4,070
25	.44	2,820	1.22	5,110	1.44	5,850			.90	4,070
26	.40	2,730	1.29	5,340	1.46	5,920			.80	3,770
27	.37	2,670	1.29	5,340	1.46	5,920			.80	3,770
28	.45	2,840	1.14	4,830	1.51	6,100			.60	3,210
29	.47	2,890	.92	4,130	1.57	6,300			.60	3,210
30	.47	2,890	.89	4,070	1.59	6,380			.70	3,480
31	.56	3,110			1.56	6,270			.70	3,480

NOTE.—The daily discharges are based on a fairly well defined curve. Discharges Oct. 4 to 9 interpolated.

Monthly discharge of Missouri River at Fort Benton, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
Aug. 17–31	3,110	2,520	2,740	81,500	A.
September	5,400	2,780	4,250	253,000	A.
October	6,380	3,830	5,220	321,000	A.
November	(a)	(a)	5,460	325,000	B.
December	5,710	3,210	4,680	288,000	A.

a Nov. 11 to Dec. 1 discharge interpolated.

TRIBUTARY BASINS.

BIGHOLE RIVER BASIN.

BIGHOLE RIVER NEAR DEWEY, MONT.

Bighole River rises in the Bitterroot Mountains, flows in an easterly direction, and unites with the Beaverhead to form Jefferson River just below Twin Bridges, Mont. The most important tributary of the Bighole is Wise River.

The valley of the Bighole is exceptionally well irrigated by water from the stream. The river also offers opportunities for power development. Good reservoir sites exist on the upper portions of the Bighole and its tributaries.

A gaging station was established September 15, 1910, at Young's bridge, 4 miles above Dewey and 11 above Divide, Mont. Wise River enters a few miles above the gaging station.

A staff gage is fastened to southeast piling of bridge on downstream side. Discharge measurements are made from the bridge.

The channel is rocky, clean, and nonshifting.

Ice is common during the winter months. A large hydroelectric power plant is in operation about 8 miles below the station.

Discharge measurements of Bighole River near Dewey, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Sept. 15	Raymond Richards	63	139	1.99	184
Nov. 8	J. C. Beebe	108	482	2.70	511

Daily gage height, in feet, and discharge, in second-feet, of Bighole River near Dewey, Mont., for 1910.

[Wm. J. Fish, observer.]

Day.	Sept.		Oct.		Nov.		Dec.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			2.30	304	2.60	430	2.71	478
2			2.32	312	2.65	452	2.61	434
3			2.35	324	2.70	474	2.60	430
4			2.85	542	2.70	474	2.60	430
5			2.65	452	2.70	474	2.60	430
6			2.55	409	2.75	496	2.60	430
7			2.50	387	2.75	496	2.50	387
8			2.50	387	2.75	496	2.53	400
9			2.50	387	2.76	500	2.50	387
10			2.50	387	2.77	505	2.50	387
11			2.50	387	2.76	500		
12			2.50	387	2.76	500		
13			2.50	387	2.76	500		
14			2.50	387	2.76	500		
15	2.00	187	2.50	387	2.77	505		

Daily gage height, in feet, and discharge, in second-feet, of Bighole River near Dewey, Mont., for 1910—Continued.

Day.	Sept.		Oct.		Nov.		Dec.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
16	2.00	187	2.40	345	2.77	505	.....	.....
17	2.10	225	2.50	387	2.78	510	.....	.....
18	2.40	345	2.50	387	2.79	515	.....	.....
19	2.40	345	2.50	387	2.79	515	.....	.....
20	2.20	264	2.40	345	2.80	519	.....	.....
21	2.10	225	2.40	345	2.80	519	.....	.....
22	2.20	264	2.40	345	2.79	515	.....	.....
23	.....	[a] 264	2.50	387	2.79	515	.....	.....
24	2.20	264	2.60	430	2.78	510	.....	.....
25	2.50	387	2.60	430	2.79	515	.....	.....
26	2.50	387	2.60	430	2.80	519	.....	.....
27	2.40	345	2.60	430	2.81	524	.....	.....
28	2.30	304	2.60	430	2.81	524	.....	.....
29	2.30	304	2.60	430	2.81	524	.....	.....
30	2.30	304	2.60	430	2.71	478	.....	.....
31	.....	.....	2.60	430	.....	.....	.....	.....

[a] Interpolated.

NOTE.—Discharges are based on a fairly well defined rating curve.

Monthly discharge of Bighole River near Dewey, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
Sept. 15–31	387	187	271	9,140	C.
October	542	304	393	24,200	C.
November	524	430	500	29,800	C.
December	478	.....	367	22,600	D.

NOTE.—Discharge estimated Dec. 11 to 31 by comparison with stations on Beaverhead River at Barratts and Jefferson River near Silverstar, Mont.

PIPESTONE CREEK BASIN.

PIPESTONE CREEK NEAR WHITEHALL, MONT.

Pipestone Creek rises near the Continental Divide, just east of Butte, Mont., flows in a southeasterly direction, and joins Jefferson River near Whitehall. Its principal tributary is the Little Pipestone.

A gaging station was established October 15, 1910, 6 miles west of Whitehall, Mont., at Peyton Allred's ranch, a short distance above the junction of the creek with the Little Pipestone.

A staff gage is fastened to a large post on the left bank of the stream directly north of the observer's house.

The bed of the creek is sandy and shifting.

Discharge measurements of Pipestone Creek near Whitehall, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Oct. 13	Raymond Richards	9	2.6	0.50	2.4
13	....do	9	2.7	.50	2.3

NOTE.—Measurements made by wading one-eighth mile below gage.

Daily gage height, in feet, of Pipestone Creek near Whitehall, Mont., for 1910.

[Peyton Allred, observer.]

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	.....	0.6	0.85	11	.....	0.6	0.8	21	0.5	0.8	0.7
2	.....	.6	.8	12	.....	.6	.8	22	.5	.8	.7
3	.....	.6	.8	13	0.5	.6	.75	23	.5	.8	.7
4	.....	.55	.85	14	.5	.5	.75	24	.5	.75	.7
5	.....	.5	.85	15	.5	.5	.7	25	.55	.75	.7
6	.....	.55	.9	16	.5	.5	.7	26	.55	.75	.7
7	.....	.55	.9	17	.5	.7	.75	27	.55	.75	.7
8	.....	.6	.85	18	.55	.8	.75	28	.55	.8	.7
9	.....	.6	.85	19	.55	.8	.75	29	.55	.8	.7
10	.....	.6	.8	20	.55	.8	.7	30	.55	.85	.7
								31	.55	.....	.7

WHITETAIL CREEK BASIN.

WHITETAIL CREEK NEAR WHITEHALL, MONT.

Whitetail Creek rises in the central part of Jefferson County and flows southward to its junction with Jefferson River near Whitehall. The stream furnishes water for irrigation.

A gaging station was established October 14, 1910, 6 miles north of Whitehall, Mont., and 1 mile above the junction of the creek with the Little Whitetail, the principal tributary. A private wagon bridge spans the stream about 300 feet below the station.

A staff gage is nailed to a large tree on the right bank of the stream.

The channel is sandy and shifting.

At low and ordinary stages discharge measurements are made by wading near the gage; at flood stages the private wagon bridge about 300 feet below the station may be used.

No gage heights were obtained for 1910.

The following discharge measurement was made by Raymond Richards:

October 14, 1910: Width, 9.5 feet; area, 4.70 square feet; gage height, 1.10 feet; discharge, 3.54 second-feet. Made by wading.

MADISON RIVER BASIN.

MADISON RIVER NEAR NORRIS, MONT.

Madison River, the largest of the three forks of the Missouri, rises in Yellowstone National Park and flows northwestward, draining through many small tributaries a heavily timbered and mountainous region. The river affords opportunity for large power and irrigation developments. On the lower portions of the stream irrigation is extensively practiced.

A gaging station was established August 12, 1910, on the public highway bridge over the Madison, about 5 miles east of Norris, Mont. Previous to this date records were obtained on the Madison as follows:

August 24, 1893 to May 1, 1897, at the Northern Pacific Railway bridge, near Three Forks, Mont.

May 2, 1897, to December 31, 1905, 5 miles below the present location, at the ranch of S. A. Black.

The gage is an ordinary staff fastened to a tubular pier on the left bank. Discharge measurements are made from the downstream side of the bridge. Cherry Creek enters the stream a few miles below the station. The stream remains open practically the entire year.

Discharge measurements of Madison River near Norris, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 13	Raymond Richards	224	421	1.69	1,480
Nov. 3	J. C. Beebe	219	379	1.60	1,260

Daily gage height, in feet, and discharge, in second-feet, of Madison River near Norris, Mont., for 1910.

[William H. Foster, observer.]

Day.	Aug.		Sept.		Oct.		Nov.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			1.5	1,050	1.7	1,500		1,380
2			1.6	1,270	1.6	1,270	1.6	1,270
3			1.5	1,050	1.9	2,020	1.6	1,270
4			1.6	1,270	1.9	2,020	1.7	1,500
5			1.6	1,270	1.8	1,750	1.6	1,270
6			1.6	1,270	1.9	2,020	1.6	1,270
7			1.5	1,050	1.7	1,500	1.5	1,050
8			1.6	1,270	1.6	1,270	1.7	1,500
9			1.7	1,500	1.7	1,500	1.6	1,270
10			1.7	1,500	1.6	1,270	1.7	1,500
11			1.7	1,500	1.7	1,500	1.6	1,270
12	1.7	1,500	1.7	1,500	1.6	1,270	1.7	1,500
13	1.7	1,500	1.6	1,270	1.6	1,270	1.7	1,500
14	1.6	1,270	1.5	1,050	1.8	1,750	1.8	1,750
15	1.65	1,380	1.6	1,270	1.9	2,020	1.7	1,500

Daily gage height, in feet, and discharge, in second-feet, of Madison River near Norris, Mont., for 1910—Continued.

Day.	Aug.		Sept.		Oct.		Nov.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
16	1.7	1,500	1.6	1,270	1.8	1,750	2.0	2,300
17	1.65	1,380	1.6	1,270	1.6	1,270	1.7	1,500
18	1.75	1,620	1.7	1,500	1.75	1,620	1.7	1,500
19	1.75	1,620	1.7	1,500	1.8	1,750	1.6	1,270
20	1.6	1,270	1.7	1,500	1.75	1,620	1.6	1,270
21	1.6	1,270	1.6	1,270	1.6	1,270	.....	.....
22	1.55	1,160	1.7	1,500	1.7	1,500	.....	.....
23	1.65	1,380	1.8	1,750	1.8	1,750	.....	.....
24	1.8	1,750	1.7	1,500	1.75	1,620	.....	.....
25	1.6	1,270	1.7	1,500	1.7	1,500	.....	.....
26	1.4	850	1.7	1,500	1.75	1,620	.....	.....
27	1.45	950	1.7	1,500	1.65	1,380	.....	.....
28	1.4	850	1.7	1,500	1.7	1,500	.....	.....
29	1.5	1,050	1.6	1,270	1.6	1,270	.....	.....
30	1.6	1,270	1.7	1,500	1.7	1,500	.....	.....
31	1.6	1,270	.....	.....	1.7	1,500	.....	.....

NOTE.—Ice after November 20. The daily discharges are based on a fairly well defined rating curve.

Monthly discharge of Madison River near Norris, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
August 12–31	1,750	850	1,310	52,000	A.
September	1,750	1,050	1,360	80,900	A.
October	2,020	1,270	1,560	95,900	A.
November 1–20	2,300	1,050	1,430	56,700	A.

GALLATIN RIVER BASIN.

WEST GALLATIN RIVER NEAR SALESVILLE, MONT.

Gallatin River proper is formed just east of Logan by the union of East and West Gallatin rivers. West Gallatin, the larger and more important stream, rises in the northwestern part of Yellowstone Park, and flows in a mountainous, timbered, and precipitous area. On the lower portions of the stream irrigation is extensively practiced.

A gaging station was maintained at the highway bridge just below the mouth of the canyon and 4 miles above Salesville, Mont., from July 18, 1895, to December 31, 1905, and was reestablished August 9, 1910.

Spanish Creek is the most important tributary above the station.

The drainage area at this point is 860 square miles.

A standard chain gage, boxed, is fastened near middle of bridge on upstream side. The datum of the gage remained constant. Discharge measurements are made from the lower side of the bridge.

The bed of stream is of gravel and small bowlders and will not shift.

Discharge measurements of West Gallatin River near Salesville, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 9	Raymond Richards	94	212	3.29	446
Nov. 2[a]	J. C. Beebe	60	199	3.22	434

[a] Made by wading below bridge. Rough section.

Daily gage height, in feet, of West Gallatin River near Salesville, Mont., for 1910.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.1	3.1	3.25	3.2	16	3.2	3.2	3.2	3.0	3.0
2	.....	3.1	3.2	3.35	3.05	17	3.1	3.2	3.3	3.0	2.95
3	.....	3.1	3.2	3.25	3.05	18	3.1	3.2	3.3	3.1	3.0
4	.....	3.2	3.2	3.25	3.15	19	3.1	3.2	3.3	3.2	3.05
5	.....	3.2	3.3	3.2	3.0	20	3.1	3.2	3.4	3.1	3.05
6	.....	3.2	3.3	3.2	3.0	21	3.0	3.2	3.2	3.1	2.95
7	.....	3.2	3.3	3.2	3.05	22	3.0	3.2	3.2	3.25	3.0
8	.....	3.2	3.3	3.2	3.1	23	3.0	3.2	3.3	3.15	3.05
9	3.3	3.2	3.2	3.2	3.0	24	3.1	3.2	3.2	3.15	3.0
10	3.2	3.2	3.3	3.1	2.9	25	3.1	3.1	3.2	3.25	2.95
11	3.2	3.2	3.2	3.1	3.0	26	3.1	3.2	3.3	3.15	3.0
12	3.2	3.2	3.2	3.2	3.0	27	3.1	3.2	3.3	3.1	3.05
13	3.4	3.2	3.3	3.05	2.95	28	3.0	3.2	3.2	3.2	3.05
14	3.2	3.2	3.2	3.05	2.95	29	3.0	3.1	3.2	3.1	2.95
15	3.2	3.2	3.2	3.15	3.0	30	3.1	3.0	3.3	3.1	3.0
						31	3.1	.....	3.2	.....	3.05

PRICKLY PEAR CREEK BASIN.

DESCRIPTION.

Prickly Pear Creek rises in the mountains in the northwestern part of Jefferson County, Mont., and takes a general northeasterly course to its junction with the Missouri near Eldorado bar in the southeastern part of Lewis and Clark County. Its principal tributaries are McClellan, Lump Gulch, Tenmile, and Silver creeks. Its upper valley is narrow and little irrigation is practiced, but below Helena the entire normal flow is diverted for irrigation.

The flood of June, 1908, was probably greater than any other in this valley for many years.

PRICKLY PEAR CREEK NEAR CLANCY, MONT.

This station was originally established July 15, 1908, about 2 miles below Clancy and 12 miles south of Helena, and about 1 mile below the mouth of Lump Gulch Creek. It was discontinued June 5, 1909. On July 12, 1910, it was reestablished at the private wagon bridge back of the ranch buildings on the Stafford ranch, and just to the right of the Great Northern Railway, about 1 mile below Clancy and just below the mouth of Lump Gulch Creek.

A staff gage is nailed to the downstream side of the bridge abutment.

All discharge measurements at the old location were made by wading near the staff gage, the datum of which remained unchanged during the period of its use.

Discharge measurements at the new location are made from the wagon bridge or by wading.

Ice is common at this station in extreme cold weather.

Discharge measurements of Prickly Pear Creek near Clancy, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 12	Raymond Richards	26	17	1.60	23
Aug. 19	B. E. Jones	16	9.6	1.46	14
Do	J. C. Beebe	16	9.7	1.46	15
Sept. 27	B. E. Jones	20	21	1.95	61
Nov. 12	do	20	18	1.85	46
Dec. 10	J. C. Beebe	28	22	1.75	35

Daily gage height, in feet, and discharge, in second-feet, of Prickly Pear Creek near Clancy, Mont., for 1910.

[H. Y. Barrow, observer.]

Day.	July.		Aug.		Sept.		Oct.		Nov.		Dec.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			1.45	14	1.85	47	1.80	41	1.79	40	1.68	29
2			1.45	14	1.90	53	1.90	53	1.79	40	1.69	30
3			1.45	14	1.90	53	1.85	47	1.78	39	1.70	31
4			1.40	12	1.80	41	1.90	53	1.75	36	1.74	35
5			1.40	12	1.80	41	1.85	47	1.71	32	1.72	33
6			1.40	12	1.80	41	1.80	41	1.74	35	1.88	50
7			1.40	12	1.90	53	1.80	41	1.77	38	1.96	62
8			1.40	12	1.85	47	1.78	39	1.76	37	1.73	34
9			1.40	12	1.85	47	1.78	39	1.79	40	1.73	34
10			1.40	12	1.80	41	1.75	36	1.79	40	1.75	36
11			1.40	12	1.80	41	1.72	33	1.79	40	2.00	.....
12	1.60	23	1.40	12	1.80	41	1.73	34	1.81	42	2.20	.....
13	1.55	20	1.40	12	1.80	41	1.72	33	1.80	41	2.58	.....
14	1.50	16	1.40	12	1.75	36	1.73	34	1.70	31	2.64	.....
15	1.50	16	1.40	12	1.75	36	1.71	32	1.64	26	2.80	.....
16	1.50	16	1.40	12	1.75	36	1.71	32	1.69	30	2.79	.....
17	1.50	16	1.45	14	1.70	31	1.70	31	1.69	30	2.76	.....
18	1.50	16	1.40	12	1.70	31	1.80	41	1.74	35	2.96	.....
19	1.50	16	1.40	12	1.70	31	1.83	45	1.75	36	3.05	.....
20	1.45	14	1.40	12	1.70	31	1.79	40	1.74	35	2.86	.....
21	1.45	14	1.40	12	1.75	36	1.77	38	1.73	34	2.96	.....
22	1.50	16	1.40	12	1.90	53	1.75	36	1.75	36	3.08	.....
23	1.50	16	1.40	12	1.95	60	1.74	35	1.75	36	2.15	.....
24	1.45	14	1.40	12	2.00	68	1.73	34	1.69	30	2.00	.....
25	1.50	16	1.40	12	2.10	84	1.77	38	1.73	34	1.82	.....
26	1.50	16	1.40	12	2.00	68	1.82	43	1.66	28	.....	.....
27	1.45	14	1.45	14	2.00	68	1.72	33	1.70	31	.....	.....
28	1.45	14	1.45	14	1.90	53	1.72	33	1.70	31	.....	.....
29	1.45	14	1.55	20	1.90	53	1.77	38	1.64	26	.....	.....
30	1.45	14	1.70	31	1.80	41	1.72	33	1.62	25	.....	.....
31	1.45	14	1.75	36	.....	.....	1.76	37	.....	.....	.....	.....

NOTE.—Ice Dec. 11 to 31. The daily discharge is based on a fairly well defined rating curve.

Monthly discharge of Prickly Pear Creek near Clancy, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
July 12–31	23	14	15.8	627	B.
August	36	12	14.0	861	A.
September	84	31	46.8	2,780	A.
October	53	31	38.4	2,360	A.
November	42	25	34.5	2,050	A.
December	62	.....	[a] 32.4	1,990	C.
The period	.....	.....	.....	10,700	

[a] Dec. 11–31 estimated because of ice.

PRICKLY PEAR CREEK AT EAST HELENA, MONT.

This station, which was established July 18, 1908, is located where the Northern Pacific Railway crosses the stream at East Helena, Mont.

McClellan and Lump Gulch creeks are the only important tributaries entering above the station; Tenmile and Silver creeks come in below. All the normal flow of this stream is used for irrigation, the greater part of the water being diverted below this station.

At the gaging section the channel is rocky, clean, and nonshifting. The bed of the stream is so extremely rough that even in low water measurements are difficult. Fair results, however, have been obtained.

A staff gage is securely fastened to the piling on the Northern Pacific Railway bridge. The gage datum has remained the same. Measurements are made by wading just below the gage or from the highway bridge near by.

Discharge measurements of Prickly Pear Creek at East Helena, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 29	W. A. Lamb	37	37	1.25	77
May 16	R. Richards	36	34	1.23	76
June 4	W. A. Lamb	26	22	1.15	61
July 6	M. E. McChristie	22	20	1.00	38
Sept. 10	C. S. Heigel	26	16	.91	28
Oct. 1	B. E. Jones	26	29	1.10	50
Nov. 14	.....do	25	21	1.00	37
Nov. 16	.....do	24	19	.93	32
Dec. 10	.....do	26	22	1.04	43
Dec. 20	.....do	24	18	.98	34

Daily gage height, in feet, of Prickly Pear Creek at East Helena, Mont., for 1910.

[J. P. McNamara, observer.]

Day.	Mar.	Apr.	May.	June.	Nov.	Day.	Mar.	Apr.	May.	June.	Nov.
1			1.2			16	1.4	1.2	1.4		.98
2		1.2	1.1	1.1		17	1.4	1.1	1.3	1.2	1.01
3		1.2	1.1	1.1		18	1.4	1.1	1.2		1.01
4		1.2	1.2			19	1.5	1.1	1.2		1.02
5			1.2			20	1.5	1.1	1.3	1.2	1.03
6	1.3	1.2	1.2			21	1.5	1.1		1.2	.94
7	1.3	1.2		1.2		22	1.5	1.1	1.2	1.3	.96
8	1.3	1.2	1.2	1.4		23	1.3	1.1		1.3	.95
9	1.3	1.5		1.3		24	1.3	1.1	1.1		1.03
10	1.4	1.4	1.5			25	1.3	1.1	1.1		1.03
11	1.4	1.3	1.4			26	1.2	1.1	1.1	1.2	1.05
12	1.4	1.3	1.2	1.3		27	1.2	1.1			1.06
13	1.4	1.3	1.2	1.3		28	1.2	1.2			1.00
14	1.4					29	1.2	1.3	1.2		1.06
15	1.4	1.2	1.2	1.3	0.96	30		1.2			1.04
						31					

NOTE.—No observer June 27 to November 14. Probable ice in January and February.

Daily discharge, in second-feet, of Prickly Pear Creek at East Helena, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	Nov.	Day.	Mar.	Apr.	May.	June.	Nov.
1		68	68	60		16	112	68	112	78	35
2		68	51	51		17	112	51	88	68	38
3		68	51	51		18	112	51	68	68	38
4		68	68	60		19	140	51	68	68	40
5		68	68	60		20	140	51	88	68	41
6	88	68	68	60		21	140	51	78	68	30
7	88	68	68	68		22	140	51	68	88	33
8	88	68	68	112		23	88	51	60	88	32
9	88	140	104	88		24	88	51	51	78	41
10	112	112	140	88		25	88	51	51	78	41
11	112	88	112	88		26	68	51	51	68	44
12	112	88	68	88		27	68	51	60	66	45
13	112	88	68	88		28	68	68	60	64	37
14	112	78	68	88		29	68	88	68	62	45
15	112	68	68	88	33	30	68	68	60	60	43
						31	68		60		

NOTE.—Daily discharges based on a fairly well-defined rating curve. Discharges estimated or interpolated for days on which gage heights were not recorded.

Monthly discharge of Prickly Pear Creek at East Helena, Mont., for 1910.

Month.	Mean discharge in second-feet.	Run-off (total in acre-feet).	Accuracy.
March	[a] 93.3	5,740	A.
April	68.6	4,080	A.
May	71.9	4,420	A.
June	73.6	4,380	B.
November	[a] 39.1	2,330	C.
December	[b] 38	2,340	C.
The period		23,300	

[a] Mar. 1 to 5 and Nov. 1 to 14 estimated by comparison with stations on Prickly Pear Creek near Clancy and from discharge measurements.

[b] Estimated by comparison with records at Clancy station and from discharge measurements made during the month.

LUMP GULCH CREEK AT CLANCY, MONT.

Lump Gulch Creek, a small mountain stream with no important tributaries, has been quite extensively used for placer mining. At present the creek furnishes some water for irrigation, but the valley is narrow and affords but little irrigable land. The normal flow of the stream is appropriated.

The gaging station, which was established July 15, 1908, is located at the ranch of Charles Zastrow, 1 mile from Clancy, 15 miles from Helena, and one-half mile above the stream's junction with Prickly Pear Creek.

The stream bed is gravelly, unclean, and shifting, making it difficult to obtain satisfactory data. Gage heights are affected by ice. No flood records have been obtained.

A staff gage is located on the left bank of the stream directly south of the observer's house. On November 12, 1910, a new gage was installed at the same location, but at a datum 1.0 foot lower than that previously used. All gage heights for 1910 have been reduced to the new datum. All measurements are made by wading.

Discharge measurements of Lump Gulch Creek at Clancy, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 12	C. S. Heidel	6	1.6	1.11	1.9
Aug. 19	B. E. Jones	3	.5	1.00	.2
Do	J. C. Beebe	2.5	.3	1.00	.2
Sept. 27	B. E. Jones	8	4.1	1.25	6.1
Nov. 12	do	10	9.7	1.39	9.7
Dec. 10[a]	J. C. Beebe	6	3.2	1.14	4.0

[a] Ice.

NOTE.—All gage heights refer to datum of gage set Nov. 12, which is 1 foot lower than that used in 1909.

Daily gage height, in feet, of Lump Gulch Creek at Clancy, Mont., for 1910.

[Chas. Zastrow, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.65	1.55	1.30	1.10	1.02	1.10	1.20	1.25
2	.....	1.65	1.55	1.30	1.10	1.02	1.10	1.20	1.25
3	.....	1.75	1.55	1.30	1.10	1.02	1.10	1.20	1.25
4	.....	1.75	1.50	1.30	1.10	1.02	1.10	1.20	1.25
5	.....	1.75	1.50	1.30	1.10	1.02	1.15	1.20	1.25
6	1.45	1.70	1.50	1.30	1.10	1.02	1.15	1.20	1.25
7	1.45	1.70	1.50	1.45	1.10	1.02	1.15	1.20	1.40
8	1.45	1.70	1.45	1.50	1.10	1.02	1.15	1.20	1.40
9	1.45	1.70	1.45	1.50	1.10	1.02	1.15	1.20	1.40
10	1.45	1.70	1.45	1.40	1.10	1.02	1.15	1.20	1.40
11	1.45	1.65	1.40	1.35	1.10	1.02	1.15	1.15	1.40
12	1.45	1.65	1.40	1.30	1.10	1.02	1.20	1.15	1.40
13	1.50	1.65	1.40	1.30	1.05	1.02	1.20	1.15	1.40
14	1.50	1.65	1.40	1.30	1.05	1.02	1.20	1.15	1.40
15	1.50	1.65	1.40	1.25	1.05	1.02	1.20	1.15	1.40

Daily gage height, in feet, of Lump Gulch Creek at Clancy, Mont., for 1910—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	1.50	1.60	1.55	1.25	1.05	1.02	1.20	1.15	1.30
17	1.60	1.60	1.60	1.25	1.05	1.02	1.20	1.20	1.28
18	1.60	1.60	1.55	1.25	1.05	1.02	1.20	1.20	1.28
19	1.70	1.55	1.50	1.25	1.05	1.02	1.20	1.20	1.28
20	1.75	1.55	1.50	1.20	1.05	1.02	1.20	1.20	1.30
21	1.80	1.55	1.40	1.20	1.05	1.02	1.25	1.20	1.30
22	1.85	1.55	1.40	1.20	1.05	1.02	1.30	1.20	1.35
23	1.90	1.55	1.40	1.20	1.05	1.02	1.30	1.20	1.35
24	1.90	1.55	1.35	1.20	1.05	1.02	1.30	1.20	1.38
25	1.50	1.55	1.35	1.20	1.05	1.02	1.25	1.20	1.38
26	1.50	1.55	1.30	1.15	1.05	1.02	1.25	1.20	1.38
27	1.50	1.60	1.40	1.15	1.05	1.02	1.25	1.20	1.38
28	1.50	1.60	1.40	1.15	1.05	1.02	1.25	1.20	1.38
29	1.60	1.60	1.40	1.15	1.05	1.10	1.25	1.20	1.38
30	1.60	1.60	1.35	1.15	1.05	1.10	1.25	1.20	1.38
31	1.60	.....	1.35	.....	1.05	1.10	.....	1.20	.....

NOTE.—All gage heights for 1910 refer to a datum 1 foot lower than that used in 1909. Ice in January, February, and December.

Daily discharge, in second-feet, of Lump Gulch Creek at Clancy, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	23	18	7.2	1.7	0.5	1.7	4.0	5.6
2	.....	23	18	7.2	1.7	.5	1.7	4.0	5.6
3	.....	29	18	7.2	1.7	.5	1.7	4.0	5.6
4	.....	29	16	7.2	1.7	.5	1.7	4.0	5.6
5	.....	29	16	7.2	1.7	.5	2.8	4.0	5.6
6	14	26	16	7.2	1.7	.5	2.8	4.0	5.6
7	14	26	16	14	1.7	.5	2.8	4.0	11
8	14	26	14	16	1.7	.5	2.8	4.0	11
9	14	26	14	16	1.7	.5	2.8	4.0	11
10	14	26	14	11	1.7	.5	2.8	4.0	11
11	14	23	11	9.2	1.7	.5	2.8	2.8	11
12	14	23	11	7.2	1.7	.5	4.0	2.8	11
13	16	23	11	7.2	1.0	.5	4.0	2.8	11
14	16	23	11	7.2	1.0	.5	4.0	2.8	11
15	16	23	11	5.6	1.0	.5	4.0	2.8	11
16	16	21	18	5.6	1.0	.5	4.0	2.8	7.2
17	21	21	21	5.6	1.0	.5	4.0	4.0	6.6
18	21	21	18	5.6	1.0	.5	4.0	4.0	6.6
19	26	18	16	5.6	1.0	.5	4.0	4.0	6.6
20	29	18	16	4.0	1.0	.5	4.0	4.0	7.2
21	32	18	11	4.0	1.0	.5	5.6	4.0	7.2
22	35	18	11	4.0	1.0	.5	7.2	4.0	9.2
23	38	18	11	4.0	1.0	.5	7.2	4.0	9.2
24	38	18	9.2	4.0	1.0	.5	7.2	4.0	10
25	16	18	9.2	4.0	1.0	.5	5.6	4.0	10
26	16	18	7.2	2.8	1.0	.5	5.6	4.0	10
27	16	21	11	2.8	1.0	.5	5.6	4.0	10
28	16	21	11	2.8	1.0	.5	5.6	4.0	10
29	21	21	11	2.8	1.0	1.7	5.6	4.0	10
30	21	21	9.2	2.8	1.0	1.7	5.6	4.0	10
31	21	.....	9.2	.....	1.0	1.7	.....	4.0	.....

NOTE.—These discharges are based on a fairly well defined rating curve.

Monthly discharge of Lump Gulch Creek at Clancy, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	[a]9.0	553	
February	.....	.....	[a]9.0	500	
March	38	9	[a]18.8	1,160	A.
April	29	18	22.3	1,330	A.
May	18	7.2	13.4	824	A.
June	16	2.8	6.57	391	B.
July	1.7	1.0	1.27	78	C.
August	1.7	.5	.616	38	D.
September	7.2	1.7	4.11	245	B.
October	4.0	2.8	3.77	232	B.
November	11	5.6	8.75	521	B.
December	.....	.....	[a]9.0	553	
The year	.....	.....	8.88	6,420	

[a] Discharge estimated Jan. 1 to Mar. 5, and month of December. Means for January, February, and December are only approximate.

TENMILE CREEK NEAR HELENA, MONT.

This station, which is located opposite the Broadwater Hotel, near Helena, Mont., was established July 8, 1908, to determine the amount of water available for irrigation and for municipal supply.

Part of the water supply of the city of Helena is taken from Tenmile Creek above the station. Two irrigation ditches also take their water from this creek above the gage. The entire low-water flow is appropriated and used before it reaches the mouth of the creek.

The principal tributaries above the gaging station are Blue Cloud, Spring, and Walker creeks; Sevenmile Creek enters 2 miles below.

The channel shifts somewhat during flood stages, but at medium and low water the conditions are good for obtaining accurate discharge data. The stream freezes partly over during the winter months.

The gage is of the staff type and is located on right bank of stream. The datum has remained the same. Measurements are made by wading.

Discharge measurements of Tenmile Creek near Helena, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 31	W. A. Lamb	23	19	2.40	42
May 15	Raymond Richards	23	18	2.30	36
July 6	M. E. McChristie	12	5.1	1.58	2.4
6	J. C. Beebe	14	5.1	1.58	2.3
Sept. 8	C. S. Heidel	.....	.....	1.12	[a].1
27	B. E. Jones	20	11	1.88	10.8
Nov. 14	.....do	20	14	1.90	9.7
16	.....do	20	12	1.78	6.4
Dec. 9	.....do	17	8.2	1.62	3.3
10	.....do	18	10	1.77	6.7

[a] Discharge estimated.

Daily gage height, in feet, of Tenmile Creek near Helena, Mont., for 1910.

[Harry Hillman, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.4	2.4	1.8	1.4	1.2	1.15	1.8	1.9	1.84
2	.....	2.4	2.4	1.8	1.4	1.2	1.15	1.8	1.9	1.84
3	.....	2.4	2.3	1.8	1.4	1.2	1.15	1.8	1.9	1.84
4	.....	2.4	2.3	1.8	1.5	1.2	1.15	1.85	1.9	1.80
5	.....	2.4	2.3	1.7	1.6	1.15	1.15	1.85	1.9	1.76
6	.....	2.4	2.3	1.7	1.6	1.15	1.15	1.85	1.9	1.74
7	2.0	2.5	2.3	1.7	1.6	1.15	1.15	1.85	1.9	1.72
8	2.0	2.5	2.3	1.8	1.6	1.15	1.15	1.85	1.9	.....
9	2.0	2.6	2.3	2.0	1.6	1.15	1.15	1.8	1.95	.....
10	1.9	2.6	2.6	2.0	1.6	1.15	1.15	1.75	1.95	1.77
11	2.0	2.7	2.4	1.9	1.6	1.15	1.2	1.75	1.95	.....
12	2.0	2.7	2.3	1.8	1.5	1.15	1.4	1.7	1.95	.....
13	2.0	2.6	2.3	1.8	1.4	1.15	1.4	1.7	1.90	.....
14	2.1	2.6	2.1	1.7	1.4	1.15	1.5	1.7	1.90	.....
15	2.2	2.6	2.3	1.7	1.4	1.15	1.6	1.7	1.82	.....
16	2.2	2.6	2.3	1.6	1.3	1.15	1.7	1.65	1.78	.....
17	2.2	2.6	2.4	1.5	1.3	1.15	1.7	1.65	1.90	.....
18	2.3	2.6	2.4	1.5	1.3	1.15	1.7	1.7	1.93	.....
19	2.4	2.7	2.4	1.4	1.3	1.15	1.6	1.7	1.92	.....
20	2.5	2.8	2.4	1.4	1.3	1.15	1.55	1.75	1.91	.....
21	2.6	2.7	2.3	1.4	1.3	1.15	1.7	1.75	1.91	.....
22	2.7	2.6	2.1	1.4	1.3	1.15	2.0	1.75	1.91	.....
23	2.6	2.6	2.1	1.7	1.3	1.15	1.9	1.8	1.91	.....
24	2.6	2.6	2.1	1.6	1.25	1.15	1.8	1.8	1.88	.....
25	2.5	2.6	2.1	1.5	1.25	1.15	1.8	1.85	1.86	.....
26	2.5	2.6	2.1	1.4	1.25	1.15	1.8	1.85	1.84	.....
27	2.4	2.6	2.0	1.4	1.25	1.15	1.9	1.85	1.63	.....
28	2.4	2.5	2.0	1.4	1.25	1.15	1.9	1.85	1.64	.....
29	2.4	2.5	1.9	1.4	1.25	1.15	1.85	1.85	1.90	.....
30	2.4	2.4	1.9	1.4	1.25	1.15	1.8	1.9	1.86	.....
31	2.4	.....	1.9	.....	1.2	1.15	.....	1.9	.....	.....

NOTE.—Ice in January, February, and after Dec. 10.

Daily discharge, in second-feet, of Tenmile Creek near Helena, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	43	43	7.0	0.8	0.2	0.15	7.0	10	8.4
2	.....	43	43	7.0	.8	.2	.15	7.0	10	8.4
3	.....	43	34	7.0	.8	.2	.15	7.0	10	8.4
4	.....	43	34	7.0	1.5	.2	.15	8.7	10	7.0
5	.....	43	34	4.5	2.7	.15	.15	8.7	10	6.0
6	.....	43	34	4.5	2.7	.15	.15	8.7	10	5.5
7	15	53	34	4.5	2.7	.15	.15	8.7	10	5.0
8	15	53	34	7.0	2.7	.15	.15	8.7	10	[a]5.4
9	15	63	34	15	2.7	.15	.15	7.0	13	[a]5.8
10	10	63	63	15	2.7	.15	.15	5.8	13	6.2
11	15	74	43	10	2.7	.15	.2	5.8	13	.....
12	15	74	34	7.0	1.5	.15	.8	4.5	13	.....
13	15	63	34	7.0	.8	.15	.8	4.5	10	.....
14	20	63	20	4.5	.8	.15	1.5	4.5	10	.....
15	26	63	34	4.5	.8	.15	2.7	4.5	7.7	.....
16	26	63	34	2.7	.4	.15	4.5	3.6	6.5	.....
17	26	63	43	1.5	.4	.15	4.5	3.6	10	.....
18	34	63	43	1.5	.4	.15	4.5	4.5	11	.....
19	43	74	43	.8	.4	.15	2.7	4.5	11	.....
20	53	85	43	.8	.4	.15	2.1	5.8	11	.....
21	63	74	34	.8	.4	.15	4.5	5.8	11	.....
22	74	63	20	.8	.4	.15	15	5.8	11	.....
23	63	63	20	4.5	.4	.15	10	7.0	11	.....
24	63	63	20	2.7	.3	.15	7	7.0	9.7	.....
25	53	63	20	1.5	.3	.15	7	8.7	9.0	.....
26	53	63	20	.8	.3	.15	7	8.7	8.4	.....
27	43	63	15	.8	.3	.15	10	8.7	3.2	.....
28	43	53	15	.8	.3	.15	10	8.7	3.4	.....
29	43	53	10	.8	.3	.15	8.7	8.7	10	.....
30	43	43	10	.8	.3	.15	7.0	10	9.0	.....
31	43	.....	10	.....	.2	.15	.....	10	.....	.....

[a] Discharges estimated.

NOTE.—These discharges are based on a well-defined rating curve.

Monthly discharge of Tenmile Creek near Helena, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	[a] 3.0	184	
February	.....	.....	[a] 4.0	222	
March	74	.....	[a] 31.2	1,920	A.
April	85	43	59.2	3,520	A.
May	63	10	30.7	1,890	A.
June	15	.8	4.44	264	B.
July	2.7	.2	1.04	64	B.
August	.2	.15	.144	9	C.
September	15.	.15	3.73	222	B.
October	10	3.6	6.85	421	B.
November	13	3.2	9.83	585	B.
December	.....	.....	[a] 4.99	307	
The year	.....	.....	13.3	9,610	

[a] Discharge estimated January, February, Mar. 1 to 6 and Dec. 11 to 31.

NOTE.—The means for January, February, and December are only approximate.

SEVENMILE CREEK NEAR BIRDSEYE, MONT.

This station, which is located at Richard Tobin's ranch, one-fourth mile from Birdseye, Mont., was established March 27, 1909. From July 16, 1908, to August 26, 1908, a station was maintained on this stream at Dr. Head's ranch, near Helena, Mont. The records determine the value of the stream for irrigation and municipal water supply.

The entire flow of this creek is appropriated and used for irrigation. A staff gage is used. All measurements are made by wading.

The channel is sandy and shifting.

Discharge measurements of Sevenmile Creek near Birdseye, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 5	Raymond Richards	10	4.3	2.40	8
June 15	....do	8	2.3	2.22	2.3
Aug. 30	C. S. Heidel	7	2.3	2.27	3.6
Nov. 16	B. E. Jones	6	2.8	2.30	4.4
Dec. 21[a]	....do	11	3.9	2.50	3.7

[a] Flow affected by ice.

Daily gage height, in feet, of Sevenmile Creek near Birdseye, Mont., for 1910.

[Richard Tobin, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.5	2.3	2.45	2.1	2.3	2.3	2.3	2.2
2	.....	2.5	2.3	2.35	2.1	2.3	2.3	2.3	2.2
3	.....	2.5	2.3	2.3	2.1	2.3	2.3	2.3	2.2
4	.....	2.5	2.3	2.3	2.1	2.3	2.3	2.3	2.2
5	.....	2.4	2.2	2.2	2.0	2.2	2.2	2.2	2.2
6	.....	2.4	2.3	2.3	2.1	2.3	2.3	2.25	2.2
7	.....	2.4	2.3	2.3	2.1	2.3	2.3	2.25	2.2
8	.....	2.4	2.3	2.3	2.1	2.3	2.3	2.3	.....
9	2.6	2.4	2.3	2.35	2.1	2.3	2.3	2.3	.....
10	2.5	2.4	2.2	2.2	2.0	2.2	2.2	2.2	.....

Daily gage height, in feet, of Sevenmile Creek near Birdseye, Mont., for 1910—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	2.6	2.4	2.3	2.3	2.1	2.3	2.3	2.35	.....
12	2.6	2.4	2.3	2.3	2.1	2.3	2.3	2.35	.....
13	2.6	2.45	2.3	2.3	2.1	2.3	2.3	2.3	.....
14	2.6	2.4	2.3	2.3	2.1	2.3	2.3	2.3	.....
15	2.45	2.4	2.2	2.25	2.2	2.2	2.2	2.2	.....
16	2.5	2.5	2.3	2.2	2.2	2.3	2.2	2.25	.....
17	2.5	2.5	2.3	2.35	2.25	2.3	2.25	2.3	.....
18	2.5	2.5	2.3	2.35	2.2	2.3	2.3	2.3	.....
19	2.4	2.45	2.3	2.3	2.2	2.3	2.2	2.3	.....
20	2.3	2.4	2.4	2.2	2.1	2.2	2.15	2.3	.....
21	2.45	2.5	2.4	2.2	2.2	2.3	2.3	2.3	.....
22	2.4	2.5	2.4	2.3	2.2	2.1	2.25	2.3	.....
23	2.4	2.5	2.4	2.3	2.3	2.1	2.2	2.3	.....
24	2.4	2.4	2.4	2.3	2.35	2.1	2.2	2.3	.....
25	2.3	2.3	2.25	2.2	2.2	2.1	2.2	2.3	.....
26	2.4	2.4	2.35	2.3	2.3	2.2	2.2	2.3	.....
27	2.4	2.4	2.3	2.2	2.3	2.3	2.25	2.3	.....
28	2.5	2.4	2.3	2.2	2.3	2.3	2.3	2.3	.....
29	2.5	2.4	2.3	2.1	2.3	2.3	2.3	2.3	.....
30	2.45	2.3	2.3	2.0	2.2	2.2	2.2	2.25	.....
31	.....	2.3	.....	2.1	2.3	.....	2.3	.....	.....

NOTE.—Ice in January, February, and after Dec. 7. The stream was undoubtedly open during March and the first part of April, but gage observations were not begun until Apr. 9.

Daily discharge, in second-feet, of Sevenmile Creek near Birdseye, Mont., for 1910.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	12	4.4	10	0.6	4.4	4.4	4.4	1.9
2	.....	12	4.4	6.2	.6	4.4	4.4	4.4	1.9
3	.....	12	4.4	4.4	.6	4.4	4.4	4.4	1.9
4	.....	12	4.4	4.4	.6	4.4	4.4	4.4	1.9
5	.....	8	1.9	1.9	.1	1.9	1.9	1.9	1.9
6	.....	8	4.4	4.4	.6	4.4	4.4	3.1	1.9
7	.....	8	4.4	4.4	.6	4.4	4.4	3.1	1.9
8	.....	8	4.4	4.4	.6	4.4	4.4	4.4	.....
9	17	8	4.4	6.2	.6	4.4	4.4	4.4	.....
10	12	8	1.9	1.9	.1	1.9	1.9	1.9	.....
11	17	8	4.4	4.4	.6	4.4	4.4	6.2	.....
12	17	8	4.4	4.4	.6	4.4	4.4	6.2	.....
13	17	10	4.4	4.4	.6	4.4	4.4	4.4	.....
14	17	8	4.4	4.4	.6	4.4	4.4	4.4	.....
15	10	8	1.9	3.1	1.9	1.9	1.9	1.9	.....
16	12	12	4.4	1.9	1.9	4.4	1.9	3.1	.....
17	12	12	4.4	6.2	3.1	4.4	3.1	4.4	.....
18	12	12	4.4	6.2	1.9	4.4	4.4	4.4	.....
19	8.0	10	4.4	4.4	1.9	4.4	1.9	4.4	.....
20	4.4	8	8.0	1.9	.6	1.9	1.2	4.4	.....
21	10	12	8.0	1.9	1.9	4.4	4.4	4.4	.....
22	8.0	12	8.0	4.4	1.9	.6	3.1	4.4	.....
23	8.0	12	8.0	4.4	4.4	.6	1.9	4.4	.....
24	8.0	8	8.0	4.4	6.2	.6	1.9	4.4	.....
25	4.4	4.4	3.1	1.9	1.9	.6	1.9	4.4	.....
26	8	8	6.2	4.4	4.4	1.9	1.9	4.4	.....
27	8	8	4.4	1.9	4.4	4.4	3.1	4.4	.....
28	12	8	4.4	1.9	4.4	4.4	4.4	4.4	.....
29	12	8	4.4	.6	4.4	4.4	4.4	4.4	.....
30	10	4.4	4.4	.1	1.9	1.9	1.9	3.1	.....
31	.....	4.4	.....	.6	4.4	.....	4.4	.....	.....

NOTE.—These discharges are based on a rating curve fairly well defined.

Monthly discharge of Sevenmile Creek near Birdseye, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January			[a] 4	246	
February			[a] 4	222	
March			[a] 10	615	
April	17	4.4	[a] 11.7	696	B.
May	12	4.4	9.07	558	A.
June	8.0	1.9	4.77	284	A.
July	10	.1	3.74	230	A.
August	6.2	.1	1.90	117	B.
September	4.4	.6	3.39	202	B.
October	4.4	1.2	3.36	207	B.
November	6.2	1.9	4.10	244	B.
December			[a] 1.9	117	
The year			5.16	3,740	

[a] Discharge estimated Jan. 1 to Apr. 8, and Dec. 8 to 31.

NOTE.—The means for January, February, March, and December are only approximate.

LITTLE PRICKLY PEAR CREEK BASIN.

DESCRIPTION.

Little Prickly Pear Creek rises in the Rocky Mountains near the continental divide, about 10 miles northwest of Marysville, Mont., and flows in a northeasterly direction to its junction with Missouri River, about 45 miles below Helena. The principal tributaries are Deadman, Marsh, Canyon, and Wolf creeks.

The valley of the Little Prickly Pear is narrow and bounded by high mountains and is exceptionally well irrigated on the upper portion of the stream. Additional water supply may be obtained by storage.

LITTLE PRICKLY PEAR CREEK NEAR MARYSVILLE, MONT.

This station, which is located on the upper portion of the stream at the Pearce ranch, 6 miles west and 3 miles north of Marysville, Mont., was established May 18, 1909, to obtain data for use in connection with irrigation.

Above this station Little Prickly Pear Creek has no important tributaries. Many small ditches take water from the stream, practically the entire flow of the stream being appropriated.

A staff gage is used, the datum of which has remained unchanged since the station was established. All measurements are made by wading.

The channel bed shifts in high water. The discharge is affected by ice during the winter months.

Discharge measurements of Little Prickly Pear Creek near Marysville, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet.*	*Sec.-ft.*
May 17	Raymond Richards	15	9.2	2.93	19.5
June 17	....do	13	7.0	2.70	11.7
Aug. 3	C. S. Heidel	10	5.7	2.49	4.9
Sept. 9	....do	10	5.0	2.49	5.5
Nov. 10[a]	....do	9	4.1	2.42	3.5

[a] Made by wading above bridge.

Daily gage height, in feet, of Little Prickly Pear Creek near Marysville, Mont., for 1910.

[Gertrude P. Johnson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.65	3.05	2.85	2.65	2.55	2.5	2.45	2.4	2.40
2	.....	2.65	3.0	2.8	2.65	2.55	2.5	2.45	2.4	2.40
3	.....	2.6	3.0	2.8	2.65	2.55	2.5	2.45	2.4	2.40
4	.....	2.6	2.95	2.8	2.65	2.55	2.5	2.45	2.4	2.40
5	.....	2.55	2.85	2.7	2.6	2.5	2.45	2.45	2.4	2.40
6	.....	2.6	2.9	2.75	2.65	2.55	2.5	2.45	2.4	2.40
7	.....	2.6	2.9	2.75	2.65	2.55	2.5	2.45	2.4	2.40
8	.....	2.6	2.9	2.75	2.65	2.55	2.5	2.45	2.35	2.40
9	.....	2.6	2.95	2.75	2.65	2.55	2.5	2.45	2.35	2.40
10	.....	2.55	2.9	2.7	2.6	2.5	2.45	2.45	2.42	2.40
11	.....	2.65	2.95	2.75	2.65	2.5	2.5	2.45	2.42	2.40
12	.....	2.65	3.0	2.75	2.65	2.5	2.5	2.45	2.42	2.40
13	2.35	2.75	3.0	2.75	2.6	2.5	2.5	2.45	2.42	2.40
14	2.35	2.8	3.0	2.75	2.6	2.5	2.5	2.45	2.42	2.40
15	2.35	2.75	2.9	2.7	2.55	2.45	2.45	2.45	2.42	2.40
16	2.4	2.8	2.95	2.75	2.6	2.5	2.5	2.45	2.42	2.39
17	2.45	2.85	2.95	2.75	2.6	2.5	2.55	2.45	2.42	2.39
18	2.5	2.85	3.0	2.75	2.6	2.5	2.55	2.45	2.42	2.39
19	2.5	2.85	2.95	2.75	2.6	2.5	2.5	2.45	2.42	2.39
20	2.45	2.85	2.9	2.7	2.55	2.45	2.5	2.45	2.42	2.39
21	2.5	2.9	2.9	2.75	2.6	2.5	2.5	2.45	2.42	2.38
22	2.5	2.95	2.9	2.75	2.6	2.5	2.5	2.45	2.42	2.38
23	2.5	3.0	2.85	2.7	2.6	2.5	2.5	2.45	2.42	2.38
24	2.5	3.0	2.85	2.7	2.6	2.5	2.5	2.45	2.42	2.38
25	2.5	3.05	2.8	2.65	2.65	2.45	2.5	2.45	2.42	2.38
26	2.55	3.1	2.85	2.7	2.6	2.5	2.5	2.45	2.42	2.38
27	2.6	3.1	2.85	2.7	2.55	2.5	2.5	2.4	2.41	2.38
28	2.65	3.1	2.85	2.7	2.55	2.5	2.5	2.4	2.40	2.38
29	2.7	3.1	2.85	2.7	2.55	2.5	2.5	2.4	2.40	2.38
30	2.6	3.05	2.8	2.6	2.5	2.45	2.5	2.4	2.40	2.38
31	2.6	.....	2.85	.....	2.55	2.5	.....	2.4	.....	2.38

NOTE.—No gage record kept prior to Mar. 13. Probably little or no ice effect.

Daily discharge, in second-feet, of Little Prickly Pear Creek near Marysville, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	10	24	17	10	6.9	5.4	4.2	3.1	3.1
2	.....	10	22	15	10	6.9	5.4	4.2	3.1	3.1
3	.....	8.4	22	15	10	6.9	5.4	4.2	3.1	3.1
4	.....	8.4	20	15	10	6.9	5.4	4.2	3.1	3.1
5	.....	6.9	17	12	8.4	5.4	4.2	4.2	3.1	3.1
6	.....	8.4	18	13	10	6.9	5.4	4.2	3.1	3.1
7	.....	8.4	18	13	10	6.9	5.4	4.2	3.1	3.1
8	.....	8.4	18	13	10	6.9	5.4	4.2	2.3	3.1
9	.....	8.4	20	13	10	6.9	5.4	4.2	2.3	3.1
10	.....	6.9	18	12	8.4	5.4	4.2	4.2	3.6	3.1

Daily discharge, in second-feet, of Little Prickly Pear Creek near Marysville, Mont., for 1910—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	10	20	13	10	5.4	5.4	4.2	3.6	3.1
12	.....	10	22	13	10	5.4	5.4	4.2	3.6	3.1
13	2.3	13	22	13	8.4	5.4	5.4	4.2	3.6	3.1
14	2.3	15	22	13	8.4	5.4	5.4	4.2	3.6	3.1
15	2.3	13	18	12	6.9	4.2	4.2	4.2	3.6	3.1
16	3.1	15	20	13	8.4	5.4	5.4	4.2	3.6	2.9
17	4.2	17	20	13	8.4	5.4	6.9	4.2	3.6	2.9
18	5.4	17	22	13	8.4	5.4	6.9	4.2	3.6	2.9
19	5.4	17	20	13	8.4	5.4	5.4	4.2	3.6	2.9
20	4.2	17	18	12	6.9	4.2	5.4	4.2	3.6	2.9
21	5.4	18	18	13	8.4	5.4	5.4	4.2	3.6	2.8
22	5.4	20	18	13	8.4	5.4	5.4	4.2	3.6	2.8
23	5.4	22	17	12	8.4	5.4	5.4	4.2	3.6	2.8
24	5.4	22	17	12	8.4	5.4	5.4	4.2	3.6	2.8
25	5.4	24	15	10	10	4.2	5.4	4.2	3.6	2.8
26	6.9	26	17	12	8.4	5.4	5.4	4.2	3.6	2.8
27	8.4	26	17	12	6.9	5.4	5.4	3.1	3.3	2.8
28	10	26	17	12	6.9	5.4	5.4	3.1	3.1	2.8
29	12	26	17	12	6.9	5.4	5.4	3.1	3.1	2.8
30	8.4	24	15	8.4	5.4	4.2	5.4	3.1	3.1	2.8
31	8.4	.....	17	.....	6.9	5.4	.....	3.1	.....	2.8

NOTE.—The above discharges are based on a rating curve that is well defined.

Monthly discharge of Little Prickly Pear Creek near Marysville, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	[a] 3.3	203	
February	.....	.....	[a] 3.0	167	
March	12	2.3	[a] 4.58	282	C.
April	26	6.9	15.4	916	A.
May	24	15	18.9	1,160	A.
June	17	8.4	12.7	756	A.
July	10	5.4	8.58	528	A.
August	6.9	4.2	5.63	346	A.
September	6.9	4.2	5.21	310	A.
October	4.2	3.1	4.02	247	B.
November	3.6	3.1	3.33	198	B.
December	3.1	2.8	2.96	182	B.
The year	.....	.....	7.30	5,300	

[a] Discharge estimated Jan. 1 to Mar. 12.

NOTE.—The means for January and February are only approximate.

LITTLE PRICKLY PEAR CREEK NEAR CANYON CREEK, MONT.

This station, which is located near Canyon Creek post office, was established April 1, 1909, to determine the quantity of water available for irrigation. Above this station Canyon, Marsh, Lost Horse, and Deadman creeks are the principal tributaries. Many small ditches take water from this stream and the low-water flow is practically all appropriated.

The channel at the gaging station will shift in flood, but at ordinary stages remains permanent.

Ice is common at this station during the winter months. The staff gage datum has remained the same. Measurements are made by wading.

Discharge measurements of Little Prickly Pear Creek near Canyon Creek, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 17	Raymond Richards	30	39	2.77	74
June 17	.....do	6	1.4	1.70	1.9
Aug. 4	C. S. Heidel	5 5	1.3	1.74	1.3
Sept. 9	.....do	14	7.9	1.99	7.7
Nov. 11	.....do	24	26	2.32	26

NOTE.—These measurements have been made by wading at different sections.

Daily gage height, in feet, of Little Prickly Pear Creek near Canyon Creek, Mont., for 1910.

[W. J. Carbis, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.65	2.85	1.75	1.6	1.6	1.9	2.05	2.25	2.32
2	.....	2.75	2.85	1.8	1.6	1.6	1.9	2.05	2.25	2.32
3	.....	2.7	2.85	1.8	1.6	1.65	1.9	2.05	2.25	2.32
4	.....	2.75	2.8	1.85	1.6	1.65	1.95	2.25	2.25	2.22
5	.....	2.7	2.8	1.85	1.6	1.65	1.95	2.30	2.35	2.22
6	.....	2.7	2.8	1.85	1.6	1.65	2.0	2.25	2.35	2.22
7	2.45	2.75	2.75	1.95	1.6	1.7	2.0	2.25	2.35	2.32
8	2.4	2.75	2.75	2.15	1.6	1.75	2.05	2.15	2.40	2.32
9	2.4	2.85	2.7	2.15	1.6	1.75	2.0	2.15	2.40	2.22
10	2.45	3.05	2.7	2.05	1.65	1.7	2.0	2.25	2.40	2.22
11	2.45	3.15	2.65	2.05	1.65	1.65	1.95	2.15	2.32	2.32
12	2.45	3.25	2.65	1.95	1.7	1.75	2.0	2.15	2.32	2.32
13	2.6	3.15	2.65	1.85	1.75	1.75	2.0	2.15	2.32	2.32
14	2.75	3.05	2.65	1.85	1.75	1.7	2.0	2.25	2.32	2.32
15	2.75	3.05	2.55	1.75	1.75	1.65	2.0	2.30	2.31	2.32
16	2.75	3.05	2.55	1.75	1.65	1.65	2.0	2.25	2.31	2.32
17	2.75	3.15	2.5	1.65	1.65	1.65	2.05	2.25	2.32	2.32
18	2.75	3.25	2.5	1.65	1.65	1.65	2.05	2.30	2.32	2.22
19	2.85	3.35	2.45	1.65	1.65	1.75	2.05	2.35	2.32	2.22
20	2.9	3.25	2.4	1.65	1.7	1.8	2.05	2.40	2.32	2.32
21	2.75	3.25	2.3	1.6	1.6	1.75	2.0	2.35	2.32	2.32
22	2.7	3.25	2.25	1.6	1.55	1.7	2.05	2.35	2.32	2.32
23	2.65	3.25	2.0	1.6	1.65	1.7	2.05	2.25	2.32	2.22
24	2.65	3.25	2.0	1.6	1.7	1.7	2.05	2.25	2.32	2.22
25	2.6	3.25	1.9	1.6	1.7	1.75	2.1	2.30	2.32	2.22
26	2.55	3.15	1.85	1.6	1.7	1.7	2.1	2.20	2.32	2.22
27	2.55	3.15	1.85	1.6	1.75	1.7	2.1	2.15	2.32	2.32
28	2.6	3.05	1.9	1.6	1.75	1.65	2.1	2.15	2.32	2.32
29	2.55	3.1	1.9	1.65	1.7	1.65	2.1	2.15	2.32	2.32
30	2.65	2.95	1.85	1.65	1.7	1.75	2.1	2.20	2.32	2.32
31	2.65	.....	.....	.....	1.65	1.7	.....	2.15	.....	2.32

NOTE.—Probably more or less affected by ice from January 1 to March 6.

Daily discharge, in second-feet, of Little Prickly Pear Creek near Canyon Creek, Mont., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			25	58	86	2.2	0	0	5	10	20	25
2			25	71	86	3	0	0	5	10	20	25
3			25	64	86	3	0	.8	5	10	20	25
4			25	71	78	4	0	.8	6.5	20	20	18
5			30	64	78	4	0	.8	6.5	23	27	18
6			30	64	78	4	0	.8	8	20	27	18
7			35	71	71	6.5	0	1.5	8	20	27	25
8			31	71	71	14	0	2.2	10	14	31	25
9			31	86	64	14	0	2.2	8	14	31	18
10			35	120	64	10	.8	1.5	8	20	31	18
11			35	138	58	10	.8	.8	6.5	14	25	25
12			35	156	58	6.5	1.5	2.2	8	14	25	25
13			51	138	58	4	2.2	2.2	8	14	25	25
14			71	120	58	4	2.2	1.5	8	20	25	25
15			71	120	46	2.2	2.2	.8	8	23	24	25
16			71	120	46	2.2	.8	.8	8	20	24	25
17			71	138	40	.8	.8	.8	10	20	25	25
18			71	156	40	.8	.8	.8	10	23	25	18
19			86	176	36	.8	.8	2.2	10	27	25	18
20			94	156	31	.8	1.5	3.0	10	31	25	25
21			71	156	23	0	0	2.2	8	27	25	25
22			64	156	20	0	0	1.5	10	27	25	25
23			58	156	8	0	.8	1.5	10	20	25	18
24			58	156	8	0	1.5	1.5	10	20	25	18
25			51	156	5	0	1.7	2.2	12	23	25	18
26			46	138	4	0	1.7	1.5	12	17	25	18
27			46	138	4	0	2.2	1.5	12	14	25	25
28			51	120	5	0	2.2	.8	12	14	25	25
29			46	129	5	.8	1.5	.8	12	14	25	25
30			58	102	4	.8	1.5	2.2	12	17	25	25
31			58	.....	3	.....	.8	1.5	.....	14	.....	25

NOTE.—These daily discharges are based on a fairly well defined rating curve. Discharges estimated for March 1 to 6.

Monthly discharge of Little Prickly Pear Creek near Canyon Creek, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	[a] 25	1,540	D.
February	.....	.....	[a] 25	1,390	D.
March	.....	.....	50.2	3,090	C.
April	176	58	119	7,080	B.
May	86	3	42.6	2,620	B.
June	14	0	3.28	195	B.
July	2.2	0	.91	56	B.
August	3	0	1.38	85	B.
September	12	5	8.88	528	B.
October	31	10	18.5	1,140	B.
November	31	20	25.1	1,490	B.
December	25	18	22.5	1,380	B.
The year	.....	.....	28.5	20,600	

[a] Estimated.

NOTE.—Means for January and February are only approximate.

DEADMAN CREEK NEAR MARYSVILLE, MONT.

This station, which is located near the ranch of Charles Johnson, one-half mile above the junction of Lost Horse Creek and Deadman Creek and 6 miles from Marysville, was established April 2, 1909, to

obtain data for use in connection with irrigation development. One or two small ditches take water from the stream.

On June 8, 1909, the staff gage was moved downstream 300 yards and was given a new datum.

The channel does not shift. Measurements are made by wading. Ice is common at this station during the winter months.

Discharge measurements of Deadman Creek near Marysville, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 17	Raymond Richards	18	9.7	2.23	24
June 17	do	16	7.4	1.99	9.3
Aug. 3	C. S. Heidel	6	3.3	1.80	3.1
Sept. 9	do	6	3.2	1.76	2.6
Nov. 10	do	7	4.0	1.93	5.9

NOTE.—Discharge measurements made by wading above the gage.

Daily gage height, in feet, of Deadman Creek near Marysville, Mont., for 1910.

[Charles Johnson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.10	2.64	2.15	1.92	1.85	1.82	1.82	1.85	1.92
2		2.08	2.65	2.15	1.92	1.85	1.82	1.82	1.85	1.92
3		2.05	2.65	2.10	1.92	1.82	1.82	1.82	1.85	1.92
4		2.05	2.65	2.10	1.92	1.82	1.82	1.82	1.85	1.92
5		2.05	2.70	2.10	1.92	1.82	1.80	1.82	1.85	1.92
6		2.05	2.70	2.10	1.92	1.82	1.80	1.82	1.90	1.92
7		2.05	2.70	2.10	1.92	1.82	1.78	1.80	1.90	1.92
8		2.05	2.75	2.10	1.92	1.82	1.77	1.80	1.91	1.92
9		2.18	2.72	2.10	1.92	1.82	1.76	1.80	1.92	1.92
10		2.28	2.76	2.10	1.92	1.82	1.74	1.80	1.92	1.92
11		2.35	2.65	2.10	1.92	1.82	1.75	1.80	1.92	1.92
12		2.40	2.58	2.10	1.92	1.82	1.75	1.80	1.95	1.92
13		2.45	2.46	2.05	1.92	1.82	1.75	1.80	1.95	1.92
14	2.00	2.40	2.30	2.05	1.92	1.82	1.78	1.80	1.95	1.94
15	2.00	2.42	2.25	2.00	1.92	1.82	1.80	1.80	1.95	1.95
16	2.00	2.40	2.22	1.98	1.92	1.82	1.82	1.80	1.95	1.95
17	2.05	2.02	2.22	1.95	1.92	1.82	1.82	1.80	1.95	1.95
18	2.08	2.05	2.20	1.95	1.92	1.82	1.80	1.80	1.95	1.95
19	2.12	2.18	2.20	1.95	1.91	1.80	1.80	1.80	1.95	1.95
20	2.18	2.22	2.18	1.95	1.90	1.80	1.80	1.80	1.95	1.95
21	2.26	2.32	2.18	1.95	1.90	1.80	1.80	1.80	1.95	1.95
22	2.30	2.35	2.18	1.95	1.90	1.80	1.80	1.80	1.95	1.95
23	2.32	2.44	2.18	1.95	1.90	1.82	1.85	1.80	1.95	1.95
24	2.32	2.50	2.18	1.95	1.90	1.82	1.85	1.82	1.92	1.95
25	2.28	2.52	2.18	1.95	1.90	1.82	1.85	1.82	1.92	1.95
26	2.20	2.55	2.15	1.95	1.90	1.82	1.85	1.82	1.92	1.95
27	2.20	2.58	2.15	1.95	1.90	1.82	1.85	1.82	1.92	1.95
28	2.10	2.59	2.15	1.95	1.90	1.82	1.85	1.82	1.92	1.92
29	2.10	2.61	2.15	1.92	1.90	1.82	1.82	1.82	1.92	1.92
30	2.05	2.64	2.15	1.92	1.90	1.82	1.82	1.85	1.92	1.92
31	2.05		2.15		1.88	1.82		1.85		

NOTE.—Probably affected by ice from January to about Mar. 13.

Daily discharge, in second-feet, of Deadman Creek near Marysville, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	15	62	18	6.3	4.3	3.6	3.6	4.3	6.3
2	.....	14	63	18	6.3	4.3	3.6	3.6	4.3	6.3
3	.....	12	63	15	6.3	3.6	3.6	3.6	4.3	6.3
4	.....	12	63	15	6.3	3.6	3.6	3.6	4.3	6.3
5	.....	12	68	15	6.3	3.6	3.1	3.6	4.3	6.3
6	.....	12	68	15	6.3	3.6	3.1	3.6	5.6	6.3
7	.....	12	68	15	6.3	3.6	2.9	3.1	5.6	6.3
8	.....	12	73	15	6.3	3.6	2.8	3.1	6.0	6.3
9	.....	20	70	15	6.3	3.6	2.7	3.1	6.3	6.3
10	.....	28	74	15	6.3	3.6	2.4	3.1	6.3	6.3
11	.....	34	63	15	6.3	3.6	2.6	3.1	6.3	6.3
12	.....	38	56	15	6.3	3.6	2.6	3.1	7.4	6.3
13	.....	43	44	12	6.3	3.6	2.6	3.1	7.4	6.3
14	9.3	38	30	12	6.3	3.6	2.9	3.1	7.4	7.1
15	9.3	40	26	9.3	6.3	3.6	3.1	3.1	7.4	7.4
16	9.3	38	23	8.6	6.3	3.6	3.6	3.1	7.4	7.4
17	12	10	23	7.4	6.3	3.6	3.6	3.1	7.4	7.4
18	14	12	22	7.4	6.3	3.6	3.1	3.1	7.4	7.4
19	16	20	22	7.4	6.0	3.1	3.1	3.1	7.4	7.4
20	20	23	20	7.4	5.6	3.1	3.1	3.1	7.4	7.4
21	26	32	20	7.4	5.6	3.1	3.1	3.1	7.4	7.4
22	30	34	20	7.4	5.6	3.1	3.1	3.1	7.4	7.4
23	32	42	20	7.4	5.6	3.6	4.3	3.1	7.4	7.4
24	32	48	20	7.4	5.6	3.6	4.3	3.6	6.3	7.4
25	28	50	20	7.4	5.6	3.6	4.3	3.6	6.3	7.4
26	22	53	18	7.4	5.6	3.6	4.3	3.6	6.3	7.4
27	22	56	18	7.4	5.6	3.6	4.3	3.6	6.3	7.4
28	15	57	18	7.4	5.6	3.6	4.3	3.6	6.3	6.3
29	15	59	18	6.3	5.6	3.6	3.6	3.6	6.3	6.3
30	12	62	18	6.3	5.6	3.6	3.6	4.3	6.3	6.3
31	12	.....	18	.....	5.1	3.6	.....	4.3	.....	6.3

NOTE.—These discharges are based on a well-defined rating curve below 30 second-feet.

Monthly discharge of Deadman Creek near Marysville, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	[a] 4	246	
February	.....	.....	[a] 4	222	
March	32	4	[a] 13.7	842	C.
April	62	10	31.3	1,860	A.
May	74	18	39.0	2,400	A.
June	18	6.3	11.0	655	A.
July	6.3	5.1	6.00	369	A.
August	4.3	3.1	3.58	220	A.
September	4.3	2.4	3.36	200	A.
October	4.3	3.1	3.37	207	A.
November	7.4	4.3	6.35	378	A.
December	7.4	6.3	6.79	418	A.
The year	.....	.....	11.0	8,020	

[a] Discharge estimated Jan. 1 to Mar. 13.

NOTE.—Means for January and February are only approximate.

LOST HORSE CREEK NEAR MARYSVILLE, MONT.

Lost Horse Creek is a small stream, fed by springs and melting snow in the mountains. It is tributary to Deadman Creek.

The gaging station, which was established April 2, 1909, is at the ranch of Charles Johnson, one-fourth mile above the junction of Lost Horse with Deadman Creek, and about 6 miles from Marysville.

One ditch receives its water from Lost Horse Creek. There are no tributaries. Channel conditions are good in low and ordinary stages, but will shift in high water. A staff gage is used. Measurements are made by wading.

Discharge measurements of Lost Horse Creek near Marysville, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 17	Raymond Richards	5	1.4	1.85	2.2
June 17	do	4	.8	1.78	.9
Aug. 3	C. S. Heidel	2.3	.3	1.62	.2
Sept. 9	do			1.50	[a] 0
Nov. 10	do			1.50	[a] 0

[a] Channel at gage dry, but there was about 2 second-feet flowing one-fourth mile below the gage. See description.

NOTE.—Measurements made by wading at various sections.

Daily gage height, in feet, of Lost Horse Creek near Marysville, Mont., for 1910.

[Charles Johnson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		1.85	2.23	1.82	1.78	1.65	1.50
2		1.85	2.23	1.82	1.78	1.65	1.50
3		1.83	2.25	1.80	1.78	1.62	1.50
4		1.83	2.28	1.80	1.78	1.62	
5		1.78	2.28	1.82	1.78	1.62	
6		1.75	2.28	1.84	1.78	1.62	
7		1.78	2.28	1.85	1.78	1.62	
8		1.83	2.31	1.85	1.78	1.62	
9		1.88	2.30	1.85	1.78	1.62	
10		1.91	2.28	1.85	1.78	1.62	
11		1.98	2.23	1.85	1.78	1.60	
12		2.01	2.21	1.85	1.78	1.60	
13		2.03	2.15	1.85	1.78	1.60	
14	1.93	2.03	2.11	1.82	1.78	1.60	
15	1.93	2.03	2.08	1.82	1.78	1.60	
16	1.93	2.03	2.03	1.80	1.78	1.60	
17	2.00	1.93	1.90	1.80	1.78	1.60	
18	2.03	1.95	1.90	1.80	1.78	1.60	
19	2.06	1.98	1.88	1.80	1.78	1.58	
20	2.11	1.98	1.88	1.80	1.76	1.58	
21	1.98	1.98	1.85	1.80	1.75	1.58	
22	1.98	1.98	1.85	1.80	1.75	1.58	
23	1.93	1.98	1.82	1.80	1.75	1.58	
24	1.93	1.98	1.82	1.80	1.75	1.58	
25	1.93	2.08	1.80	1.80	1.75	1.58	
26	1.88	2.15	1.80	1.80	1.75	1.55	
27	1.88	2.18	1.82	1.80	1.75	1.55	
28	1.83	2.18	1.82	1.80	1.75	1.55	
29	1.83	2.23	1.82	1.80	1.75	1.55	
30	1.83	2.23	1.82	1.78	1.75	1.55	
31	1.83		1.82		1.70	1.55	

NOTE.—Probably slightly affected by ice during January, February, and first part of March.

Daily discharge, in second-feet, of Lost Horse Creek near Marysville, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Day.	Mar.	Apr.	May.	June.	July.	Aug.
1	.....	1.9	6.6	1.6	1.3	0.4	16	2.8	4.0	4.0	1.4	1.3	0.2
2	.....	1.9	6.6	1.6	1.3	.4	17	3.6	2.8	2.4	1.4	1.3	.2
3	.....	1.7	6.8	1.4	1.3	.3	18	4.0	3.0	2.4	1.4	1.3	.2
4	.....	1.7	7.2	1.4	1.3	.3	19	4.4	3.4	2.2	1.4	1.3	.2
5	.....	1.3	7.2	1.6	1.3	.3	20	5.0	3.4	2.2	1.4	1.1	.2
6	.....	1.1	7.2	1.8	1.3	.3	21	3.4	3.4	1.9	1.4	1.1	.2
7	.....	1.3	7.2	1.9	1.3	.3	22	3.4	3.4	1.9	1.4	1.1	.2
8	.....	1.7	7.6	1.9	1.3	.3	23	2.8	3.4	1.6	1.4	1.1	.2
9	.....	2.2	7.5	1.9	1.3	.3	24	2.8	3.4	1.6	1.4	1.1	.2
10	.....	2.5	7.2	1.9	1.3	.3	25	2.8	4.6	1.4	1.4	1.0	.2
11	.....	3.4	6.6	1.9	1.3	.2	26	2.2	5.6	1.4	1.4	1.0	.1
12	.....	3.7	6.3	1.9	1.3	.2	27	2.2	5.6	1.6	1.4	1.0	.1
14	.....	4.0	5.5	1.9	1.3	.2	28	1.7	5.6	1.6	1.4	1.0	.1
14	2.8	4.0	5.0	1.6	1.3	.2	29	1.7	6.6	1.6	1.4	1.0	.1
15	2.8	4.0	4.6	1.6	1.3	.2	30	1.7	6.6	1.6	1.3	1.0	.1
							31	1.7	.....	1.6	.....	.7	.1

NOTE.—These discharges are based on a rating curve fairly well defined below 3 second-feet.

Monthly discharge of Lost Horse Creek near Marysville, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	5.0	.....	[a] 2.26	139	C.
April	6.6	1.1	3.37	205	C.
May	7.6	1.4	4.20	258	C.
June	1.9	1.3	1.56	93	C.
July	1.3	.7	1.19	73	C.
August	.4	.1	.219	13	C.

[a] Discharge estimated; Mar. 1 to 13.

NOTE.—There was very litle flow during January, February, and September to December. Estimated total run-off in acre-feet for year, 828.

MARSH CREEK NEAR MARYSVILLE, MONT.

Marsh Creek, a small stream, without tributaries, rises in the mountains about 10 miles from Marysville. The station was established April 1, 1909, and is located at the Hartmiller ranch, about 1 mile above the junction of Marsh Creek with the Little Prickly Pear. The creek supplies no important ditches. Measurements are made by wading near the staff gage.

Discharge measurements of Marsh Creek near Marysville, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec. ft.*
May 17	Raymond Richards	8	2.7	1.61	5.3
June 17	.....do	8	1.9	1.47	3.9
Aug. 4	C. S. Heidel	7	1.8	1.25	2.0
Sept. 9	.....do	5	2.2	1.30	1.7
Nov. 10	.....do	5	2.2	1.30	1.4

NOTE.—Discharge measurements are made by wading at various sections.

Daily gage height, in feet, of Marsh Creek near Marysville, Mont., for 1910.

[J. Hartmiller, jr., observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.62	1.5	1.45	1.25	1.3	1.3	1.25	1.25
2	.....	1.62	1.5	1.4	1.25	1.3	1.25	1.25	1.25
3	1.47	1.62	1.5	1.4	1.2	1.3	1.25	1.25	1.25
4	1.47	1.62	1.5	1.5	1.2	1.3	1.3	1.3	1.25
5	1.47	1.62	1.5	1.35	1.2	1.3	1.3	1.3	1.25
6	1.47	1.62	1.5	1.35	1.2	1.3	1.3	1.3	1.25
7	1.47	1.62	1.5	1.35	1.25	1.3	1.25	1.3	1.25
8	1.47	1.57	1.5	1.35	1.25	1.3	1.25	1.3	1.25
9	1.57	1.57	1.5	1.35	1.2	1.3	1.25	1.3	1.25
10	1.57	1.67	1.5	1.35	1.2	1.3	1.25	1.3	1.25
11	1.62	1.62	1.4	1.35	1.25	1.3	1.25	1.3	.....
12	1.62	1.62	1.4	1.35	1.2	1.3	1.25	1.33	.....
13	1.62	1.57	1.4	1.3	1.2	1.3	1.25	1.33	.....
14	1.62	1.57	1.4	1.3	1.25	1.3	1.25	1.30	.....
15	1.62	1.57	1.4	1.3	1.2	1.3	1.25	1.27	.....
16	1.62	1.67	1.45	1.3	1.25	1.3	1.25	1.27	.....
17	1.57	1.65	1.45	1.2	1.2	1.3	1.25	1.27	.....
18	1.57	1.6	1.45	1.2	1.2	1.3	1.25	1.27	.....
19	1.57	1.6	1.45	1.2	1.2	1.25	1.25	1.27	.....
20	1.57	1.6	1.5	1.25	1.2	1.25	1.25	1.27	.....
21	1.62	1.65	1.5	1.25	1.2	1.25	1.25	1.27	.....
22	1.62	1.6	1.5	1.25	1.2	1.25	1.25	1.29	.....
23	1.62	1.55	1.4	1.25	1.2	1.25	1.25	1.29	.....
24	1.62	1.55	1.4	1.25	1.25	1.3	1.25	1.29	.....
25	1.62	1.55	1.4	1.25	1.25	1.25	1.25	1.27	.....
26	1.62	1.55	1.4	1.25	1.25	1.25	1.3	1.25	.....
27	1.62	1.55	1.4	1.25	1.2	1.25	1.3	1.25	.....
28	1.62	1.5	1.4	1.3	1.2	1.25	1.3	1.25	.....
29	1.62	1.5	1.4	1.3	1.3	1.25	1.3	1.25	.....
30	1.62	1.5	1.5	1.3	1.3	1.25	1.3	1.25	.....
31	.....	1.5	.....	1.3	1.3	.....	1.25	.....	.....

NOTE.—Gage heights probably affected by ice during January and February. Little or no ice during March. Ice existed after Dec. 10.

Daily discharge, in second-feet, of Marsh Creek near Marysville, Mont., for 1910.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.4	5.0	3.6	3.2	2.0	1.7	1.5	1.3	1.3
2	3.4	5.0	3.6	2.8	2.0	1.7	1.5	1.3	1.3
3	3.4	5.0	3.6	2.8	1.8	1.7	1.5	1.3	1.3
4	3.4	5.0	3.6	3.6	1.8	1.7	1.6	1.4	1.3
5	3.4	5.0	3.6	2.5	1.8	1.7	1.6	1.4	1.3
6	3.4	5.0	3.6	2.5	1.8	1.7	1.6	1.4	1.3
7	3.4	5.0	3.6	2.5	2.0	1.7	1.5	1.4	1.3
8	3.4	4.4	3.6	2.5	1.9	1.7	1.5	1.4	1.3
9	4.4	4.4	3.6	2.5	1.8	1.7	1.5	1.4	1.3
10	4.4	5.8	3.6	2.5	1.8	1.7	1.5	1.4	1.3
11	5.0	5.0	2.8	2.5	1.9	1.7	1.5	1.4	.....
12	5.0	5.0	2.8	2.5	1.8	1.7	1.4	1.4	.....
13	5.0	4.4	2.8	2.2	1.8	1.7	1.4	1.4	.....
14	5.0	4.4	2.8	2.2	1.9	1.7	1.3	1.4	.....
15	5.0	4.4	2.8	2.2	1.8	1.7	1.3	1.4	.....
16	5.0	5.8	3.2	2.2	1.9	1.7	1.3	1.4	.....
17	4.4	5.4	3.2	1.8	1.7	1.7	1.3	1.4	.....
18	4.4	4.7	3.2	1.8	1.7	1.7	1.3	1.4	.....
19	4.4	4.7	3.2	1.8	1.7	1.6	1.3	1.4	.....
20	4.4	4.7	3.6	2.0	1.7	1.6	1.3	1.4	.....
21	5.0	5.4	3.6	2.0	1.7	1.6	1.3	1.3	.....
22	5.0	4.7	3.6	2.0	1.7	1.6	1.3	1.3	.....
23	5.0	4.2	2.8	2.0	1.7	1.5	1.3	1.3	.....
24	5.0	4.2	2.8	2.0	1.8	1.6	1.3	1.3	.....
25	5.0	4.2	2.8	2.0	1.8	1.5	1.3	1.3	.....
26	5.0	4.2	2.8	2.0	1.8	1.5	1.5	1.3	.....
27	5.0	4.2	2.8	2.0	1.7	1.5	1.4	1.3	.....
28	5.0	3.6	2.8	2.2	1.7	1.5	1.4	1.3	.....
29	5.0	3.6	2.8	2.2	1.8	1.5	1.4	1.3	.....
30	5.0	3.6	3.6	2.2	1.8	1.5	1.4	1.3	.....
31	.....	3.6	.....	2.2	1.8	.....	1.3	.....	.....

NOTE.—These discharges are based on a rating curve poorly defined. Discharges Apr. 1 and 2 estimated.

Monthly discharge of Marsh Creek near Marysville, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	[a] 1.50	92	
February	.....	.....	[a] 1.50	83	
March	.....	.....	[a] 3.00	184	
April	5.0	3.4	4.45	265	C.
May	5.8	3.6	4.63	285	C.
June	3.6	2.8	3.23	192	C.
July	3.6	1.8	2.30	141	C.
August	2.0	1.7	1.80	111	C.
September	1.7	1.5	1.64	98	C.
October	1.6	1.3	1.41	87	C.
November	1.4	1.3	1.36	81	C.
December	.....	.....	[b] 1.30	80	
The year	.....	.....	2.34	1,700	

[a] Estimated. [b] Discharge Dec. 11 to 31 estimated.

NOTE.—The means for January, February, March, and December are only approximate.

DEARBORN RIVER BASIN.

DESCRIPTION.

Dearborn River rises on the eastern slope of the Rocky Mountains in Lewis and Clark County, Mont., and takes a general southeasterly course to its junction with the Missouri about 40 miles southwest of Great Falls.

The construction of a project under the Carey Act to reclaim about 30,000 acres of land was undertaken several years ago. The water supply for this project comes from the natural flow of the Dearborn at a point just below the mouth of Falls Creek.

DEARBORN RIVER NEAR CLEMONS, MONT.

This station, which was established May 4, 1908, to obtain information concerning the amount of water available for irrigation, is located 2 miles above Clemons, Mont., and half a mile above the head works of the reclamation project.

The only important tributary near the station is Falls Creek, which enters one-half mile below. The drainage area is 110 square miles.

Measurements at this station are made from cable located just above the gage and by wading. Owing to the fact that the gage is located some 2 miles from the observer's house observations were not made every day. Interpolations made are believed to be fairly accurate. The stream freezes over during the winter and no record of gage heights is kept. The datum of the staff gage was lowered 1.0 foot on October 21, 1910, and all gage heights for the year were consequently changed.

Discharge measurements of Dearborn River near Clemons, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 27	Raymond Richards			2.08	427
May 27	do	70	86	1.66	237
July 14	M. E. McChristie	60	42	1.06	68
Aug. 28	do	43	44	.02	32
Oct. 11	Raymond Richards	57	37	.8	50
Nov. 22	J. C. Beebe	58	74	.96	42

NOTE.—Measurement Apr. 27 made at footbridge below mouth of Falls Creek. Measured discharge 576 second-feet. Discharge of Falls Creek Apr. 27, 149 second-feet subtracted to give flow past gaging station on Dearborn River. All other discharge measurements at this station were made by wading above mouth of Falls Creek.

Daily gage height, in feet, of Dearborn River near Clemons, Mont., for 1910.

[Dr. O. A. Kenck, observer,]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			1.68	1.60	1.22	0.95	0.82	1.00		0.94
2					1.22	.94			0.95	
3		1.33		1.54	1.19		.84	1.00		.90
4			1.72			.96	.84		.95	
5				1.47	1.18		.84			.90
6	1.05		2.20	1.46		.99	.84		.95	
7				1.46	1.16	.80		.99		.87
8			1.90				.86	.99	.95	
9				1.45	1.14	.90		.99		.87
10		1.54	2.00	1.45			.89	.97	.96	
11				1.45	1.10	.88		.97		.85
12			1.80		1.09		.93		.96	
13	1.18			1.43			1.00			.85
14			1.75		1.06	.85			.98	
15			2.69	1.42			1.19			.85
16					1.06	.85	1.30	.95	.98	
17			1.56	1.44	1.05			.95	.98	.84
18						.84	1.23			
19				1.44	1.03				.98	.84
20			1.57			.84	1.21			
21	1.21			1.47	1.02				.98	.87
22			1.55			.83	1.20			
23				1.35	1.00			.92	.96	.93
24					1.00	.83	1.18			1.10
25			1.60	1.31				.92	.96	
26					.98	.83	1.15			1.48
27	1.25	2.10	1.66	1.27				.92	.95	
28					.95	.82	1.15			1.61
29		1.88	1.58	1.23				.94	.95	
30					.97	.82	1.15			
31			1.63					.95		1.63

NOTE.—Ice during January and February and after Dec. 20.

Daily discharge, in second-feet, of Dearborn River near Clemons, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		119	235	205	97	50	31	58	50	49
2		121	241	195	97	49	32	58	50	46
3		123	247	185	91	50	34	58	50	43
4		131	252	174	90	52	34	57	50	43
5		139	372	162	89	54	34	56	50	43
6	66	147	492	159	86	56	34	56	50	40
7	69	155	412	159	84	28	36	56	50	38
8	72	163	333	158	83	36	37	56	50	38
9	75	174	358	156	82	43	40	56	51	38
10	78	185	383	156	78	42	42	53	52	37

Daily discharge, in second-feet, of Dearborn River near Clemons, Mont., for 1910—Contd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	81	200	334	156	74	40	44	53	52	36
12	84	215	286	153	72	38	47	52	52	36
13	89	230	275	150	70	38	58	52	54	36
14	88	241	264	148	68	36	74	51	55	36
15	89	260	780	147	68	36	91	51	55	36
16	90	275	486	150	68	36	115	50	55	35
17	91	290	191	153	66	35	108	50	55	34
18	92	305	192	153	64	34	100	49	55	34
19	93	320	194	153	63	34	98	49	55	34
20	94	335	195	158	62	34	95	48	55	.....
21	95	350	192	162	61	33	94	48	55	.....
22	96	365	188	145	60	32	93	47	54	.....
23	97	380	194	128	58	32	91	46	52	.....
24	98	395	200	123	58	32	89	46	52	.....
25	100	410	205	118	56	32	86	46	52	.....
26	102	425	216	113	55	32	84	46	51	.....
27	104	436	228	108	52	32	84	46	50	.....
28	107	380	213	104	50	31	84	48	50	.....
29	110	324	198	100	52	31	84	49	50	.....
30	113	280	207	98	53	31	84	50	50	.....
31	116	.....	216	.....	52	31	.....	50	.....	.....

NOTE.—These discharges are based on a rating curve well defined between 20 and 520 second-feet. Discharges interpolated for days on which gage heights were not read.

Monthly discharge of Dearborn River near Clemons, Mont., for 1910.

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	[a]60	0.545	0.63	3,690	
February	.....	.....	[a]65	.591	.62	3,610	
March	116	.....	[a]87.6	.796	.92	5,380	C.
April	436	119	263	2.39	2.67	15,600	C.
May	492	188	283	2.57	2.96	17,400	A.
June	205	98	148	1.35	1.51	8,810	A.
July	97	52	69.6	.633	.73	4,280	A.
August	56	31	37.7	.343	.40	2,320	A.
September	115	31	68.6	.624	.70	4,080	A.
October	58	46	51.3	.466	.54	3,150	A.
November	55	50	52.1	.474	.53	3,100	A.
December	49	.....	[a]36.8	.335	.39	2,260	C.
The year	.....	.....	102	.926	12.60	73,700	

[a] Discharge estimated Jan. 1 to Mar. 5 and Dec. 20 to 30.

NOTE.—The means for January and February are only approximate.

FALLS CREEK NEAR CLEMONS, MONT.

This station, which is located 1½ miles above Clemons, Mont., and 500 feet above the mouth of the creek, was established May 4, 1908, to obtain data for use in connection with water-power and irrigation development.

Falls Creek has a large fall above the gaging station and affords opportunities for water-power development. No water is diverted from this stream, its entire flow reaching Dearborn River.

No records are kept during the winter, as the gage heights are affected by ice. The datum of the staff gage has remained unchanged.

Measurements are made by wading or from a recently constructed cable. Observations are fragmentary on account of the great distance the observer lives from the gage. Interpolations made are believed to be fairly accurate.

Discharge measurements of Falls Creek near Clemons, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 27	Raymond Richards	45	49	1.69	149
May 27	do	33	37	1.38	91
July 14	M. E. McChristie	30	20	.91	31
Aug. 28	do	27	14	.73	18
Oct. 21	Raymond Richards	28	21	.90	25
Nov. 22	J. C. Beebe	26	16	.81	18

NOTE.—All measurements were made by wading.

Daily gage height, in feet, of Falls Creek near Clemons, Mont., for 1910.

[Dr. O. A. Kenck, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			1.42	1.30	1.01	0.81	0.75	0.98		0.80
2					1.01	.81			0.82	
3		1.47		1.27	1.00		.75	.98		.80
4			1.43			.80	.74		.83	
5				1.20	.99		.74			.79
6	0.89		1.77	1.20		.78	.74		.82	
7				1.18	.99	.77		.96		.77
8			1.52				.76	.96	.82	
9				1.18	.98	.77		.96		.77
10		1.22	1.72	1.18			.81	.96	.81	
11				1.20	.95	.77		.96	.81	.77
12			1.52		.95		.83		.81	
13	.97			1.18			.85		.80	.76
14			1.49		.91	.76			.80	
15			1.42	1.16			.87			.76
16					.90	.76	.91	.94	.80	
17			1.32	1.17	.89			.94	.80	.76
18						.75	.98			
19				1.16	.89				.80	.76
20			1.32			.75	.98			
21	1.03			1.18	.89				.80	.81
22			1.31			.73	1.00			
23				1.10	.88			.80	.81	.84
24					.88	.72	.99			.90
25			1.34	1.08				.80	.81	
26					.85	.72	1.02			1.52
27	1.12	1.72	1.40	1.05				.80	.81	
28					.82	.73	1.00			1.69
29		1.62	1.30	1.02				.80	.80	
30					.81	.73	.99			
31			1.32					.82		1.77

NOTE.—Ice during January, February, and Dec. 20 to 30.

Daily discharge, in second-feet, of Falls Creek near Clemons, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	70	91	71	36	22	18	33	22	21
2	.....	85	91	69	36	22	18	33	22	21
3	.....	100	92	67	35	22	18	33	22	21
4	.....	90	92	62	34	21	18	33	23	20
5	.....	85	128	57	34	20	18	32	23	20
6	26	80	164	57	34	20	18	32	22	20
7	27	75	136	55	34	20	18	32	22	20
8	28	70	109	55	34	20	19	32	22	20
9	29	65	130	55	33	20	20	32	22	20
10	30	60	152	55	32	20	22	32	22	20
11	31	65	130	57	31	20	22	32	22	20
12	32	70	109	56	31	20	23	31	22	19
13	33	75	106	55	30	19	24	31	21	19
14	34	80	103	54	28	19	24	31	21	19
15	34	85	91	52	27	19	25	31	21	19
16	35	90	82	52	27	19	28	30	21	19
17	35	95	74	53	26	18	34	30	21	19
18	36	100	74	53	26	18	41	29	21	19
19	36	105	74	52	26	18	41	28	21	19
20	37	110	74	54	26	18	41	26	21	.....
21	38	115	74	55	26	18	38	24	21	.....
22	39	120	73	50	26	17	35	22	22	.....
23	40	130	74	45	26	17	38	21	22	.....
24	42	135	76	44	26	17	42	21	22	.....
25	44	140	77	43	25	17	40	21	22	.....
26	46	145	82	42	24	17	37	21	22	.....
27	47	152	87	40	23	17	36	21	22	.....
28	50	140	79	38	22	17	35	21	22	.....
29	55	129	71	37	22	17	34	21	21	.....
30	60	110	72	36	22	17	34	22	21	.....
31	65	.....	74	.....	22	17	.....	22	.....	.....

NOTE.—These discharges are based on a well-defined rating curve. Discharges interpolated on days when gage was not read.

Monthly discharge of Falls Creek near Clemons, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	[a] 25	1,540	
February	.....	.....	[a] 25	1,390	
March	65	.....	[a] 36.6	2,250	C.
April	152	60	99.0	5,890	C.
May	164	71	94.9	5,840	B.
June	71	36	52.3	3,110	B.
July	36	22	28.5	1,750	B.
August	22	17	18.8	1,160	B.
September	41	18	28.6	1,700	B.
October	33	21	27.7	1,700	B.
November	23	21	21.7	1,290	B.
December	21	.....	[a] 19.5	1,200	C.
The year	.....	.....	39.8	28,800	

[a] Discharge estimated Jan. 1 to Mar. 5 and Dec. 20 to 31.

NOTE.—The means for January and February are only approximate.

SUN RIVER BASIN.

DESCRIPTION.

Sun River rises on the eastern slope of the Rocky Mountains in northwestern Montana, flows southward for about 60 miles, then, turning abruptly, flows eastward through a canyon, emerging on a level plain, through which it runs for 75 miles to its junction with

the Missouri at Great Falls. The area of the drainage basin is about 2,240 square miles.

South Fork and Willow Creek, its only important tributaries, rise in the mountains and are perennial streams. The others are small intermittent streams whose drainage areas lie entirely within the plains region.

The valley of Sun River proper is 1 to 3 miles wide and the river flows 5 to 25 feet below its general surface. Steeply sloping bluffs, about 300 feet high, border this valley, and between these bluffs and the adjoining river valley are comparatively smooth bench lands. The highest peak in the mountains stands about 8,900 feet above sea level; the altitude of the river at the canyon where it leaves the mountains is 4,450 feet; at its mouth it is 3,300 feet above sea level.

The mountainous part of the basin is included in the Lewis and Clark National Forest and is heavily timbered. The plains section is treeless except for a few willows and cottonwoods along the streams.

The mean annual rainfall ranges from 12 inches in the plains region to about 45 inches in the mountainous sections. The heaviest rainfall occurs during the month of June, but the regular June floods are caused by the melting snow in the mountains. During the greater part of the winter season all the streams are frozen over.

Much of the land in the valley has been irrigated, and the ordinary summer flow of the stream is practically all utilized. The United States Reclamation Service has started construction on an irrigation project that will store the flood water of Sun River and its tributaries and carry it to the higher bench lands at the north of the valley, where 260,000 acres of irrigable land can be reclaimed. A number of reservoir sites have been selected, the largest being the Warm Springs reservoir, with a capacity of 156,800 acre-feet. The other reservoirs are the Willow Creek, with a capacity of 84,320 acre-feet; the Pishkun, with a capacity of 45,747 acre-feet; and the Benton Lake, with a capacity of 140,200 acre-feet.

Natural power opportunities are good, as Sun River has a minimum flow at the point where it leaves the mountains of 150 second-feet and a fall of about 40 feet to the mile.

NORTH FORK OF SUN RIVER NEAR AUGUSTA, MONT.

This station, which is situated below the head of the Kilraven ditch, near Christian's ranch, 12 miles northwest of Augusta and 21 miles southwest of Chouteau, Mont., was established October 31, 1903, to determine the amount of water available for storage and irrigation.

The only important tributaries are Willow Creek and the South Fork of Sun River, both of which enter several miles below the gaging station. Very little water is diverted above the station, but below nearly all of the valley land is irrigated from this stream.

The datum of the chain gage has not been changed since the station was established. Conditions for obtaining accurate discharge data are excellent except during the winter months, when the discharge is affected by ice.

Measurements are made from a cable.

Discharge measurement of North Fork of Sun River near Augusta, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 29	Raymond Richards	145	720	3.97	3,360
May 25	....do	150	750	4.08	3,750
July 12	J. C. Beebe	149	340	1.44	749
Aug. 26[a]	M. E. McChristie	108	216	.64	270
Oct. 15	B. E. Jones	135	237	.85	325
Nov. 20[a]	J. C. Beebe	106	124	.95	354

[a] Made by wading.

Daily gage height, in feet, of North Fork of Sun River near Augusta, Mont., for 1910.

[J. R. King, jr., observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.2	3.2	3.7	2.2	1.0	0.7	0.6	0.8	0.8
2	.....	1.2	3.6	3.5	2.2	1.0	.7	.6	.8	.8
3	.....	1.1	3.8	3.2	2.2	1.0	.6	.7	.8	.8
4	.....	1.2	4.1	2.8	2.4	1.0	.6	.7	.8	.8
5	.....	1.2	4.4	3.1	2.4	1.0	.6	.7	.9	.8
6	.....	1.3	4.6	3.2	2.3	1.0	.7	.7	.9	.8
7	.....	1.6	4.9	3.1	2.3	1.0	.7	.7	.9	.8
8	.....	1.7	5.1	2.9	2.3	1.0	.7	.7	.9	.8
9	.....	1.9	4.8	2.7	2.3	.9	.7	.8	1.1	.8
10	.....	2.3	4.6	2.8	2.1	.9	.7	.8	.9	.8
11	.....	2.5	4.4	3.0	1.8	.8	.7	.8	.9	.....
12	.....	2.5	3.9	2.9	1.5	.8	.7	.8	1.0	.....
13	.9	2.5	3.6	2.9	1.5	.7	.6	.8	1.0	.....
14	.9	2.4	3.5	2.9	1.4	.7	.6	.8	.9	.7
15	.9	2.4	3.4	2.8	1.3	.7	.6	.8	.9	.....
16	1.0	2.4	3.1	2.8	1.3	.7	.6	.8	.9	.8
17	1.1	2.6	3.1	2.8	1.2	.7	.6	.8	.9	.....
18	1.1	2.8	3.2	2.8	1.2	.7	.6	.8	.9	.....
19	1.2	3.1	3.2	2.8	1.2	.7	.6	.8	.9	.7
20	1.6	3.2	3.1	2.6	1.2	.7	.6	.8	.9	.....
21	1.8	3.1	3.2	2.5	1.2	.7	.6	.8	.9	.8
22	2.1	3.1	3.2	2.5	1.2	.7	.6	.8	.9	.....
23	2.2	3.2	3.2	2.4	1.2	.7	.6	.8	.9	.9
24	1.8	3.4	3.4	2.3	1.2	.7	.6	.8	1.0	.....
25	1.7	3.6	4.1	2.3	1.2	.7	.6	.8	1.0	1.0
26	1.7	4.1	4.2	2.4	1.1	.7	.6	1.5	.9	.....
27	1.7	4.5	4.0	2.3	1.1	.7	.6	1.1	.8	1.1
28	1.6	4.6	3.4	2.3	1.1	.7	.6	.8	.8	.....
29	1.5	4.0	3.2	2.3	1.1	.7	.6	.8	.8	1.0
30	1.3	3.6	3.3	.....	1.1	.7	.6	.8	.8	.....
31	1.2	.....	3.4	.....	1.1	.7	.....	.8	.....	1.0

NOTE.—Ice January 1 to about March 12 and from about December 22 to 31.

Daily discharge, in second-feet, of North Fork of Sun River near Augusta, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	510	2,470	3,110	1,350	400	275	240	315	315
2	.....	510	2,980	2,850	1,350	400	275	240	315	315
3	.....	450	3,240	2,470	1,350	400	240	275	315	315
4	.....	510	3,640	1,990	1,550	400	240	275	315	315
5	.....	510	4,060	2,350	1,550	400	240	275	355	315
6	.....	580	4,340	2,470	1,450	400	275	275	355	315
7	.....	815	4,760	2,350	1,450	400	275	275	355	315
8	.....	895	5,040	2,110	1,450	400	275	275	355	315
9	.....	1,070	4,620	1,880	1,450	355	275	315	450	315
10	.....	1,450	4,340	1,990	1,250	355	275	315	355	315
11	.....	1,660	4,060	2,230	980	315	275	315	355	305
12	.....	1,660	3,370	2,110	735	315	275	315	400	295
13	355	1,660	2,980	2,110	735	275	240	315	400	285
14	355	1,550	2,590	2,110	655	275	240	315	355	275
15	355	1,550	2,720	1,990	580	275	240	315	355	295
16	400	1,550	2,350	1,990	580	275	240	315	355	315
17	450	1,770	2,350	1,990	510	275	240	315	355	300
18	450	1,990	2,470	1,990	510	275	240	315	355	290
19	510	2,350	2,470	1,990	510	275	240	315	355	275
20	815	2,470	2,350	1,770	510	275	240	315	355	295
21	980	2,350	2,470	1,660	510	275	240	315	355	315
22	1,250	2,350	2,470	1,660	510	275	240	315	355	.....
23	1,350	2,470	2,470	1,550	510	275	240	315	355	.....
24	980	2,720	2,720	1,450	510	275	240	315	400	.....
25	895	2,980	3,640	1,450	510	275	240	315	400	.....
26	895	3,640	3,780	1,550	450	275	240	735	355	.....
27	895	4,200	3,500	1,450	450	275	240	450	315	.....
28	815	4,340	2,720	1,450	450	275	240	315	315	.....
29	735	3,500	2,470	1,450	450	275	240	315	315	.....
30	580	2,980	2,590	1,400	450	275	240	315	315	.....
31	510	.....	2,720	.....	450	275	.....	315	.....	.....

NOTE.—These discharges are based on a rating curve that is fairly well defined between 200 and 4,000 second-feet. Discharges interpolated on days in December with missing gage heights.

Monthly discharge of North Fork of Sun River near Augusta, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	[a] 400	24,600	
February	.....	.....	[a] 375	20,800	
March	1,350	355	[a] 579	35,600	C.
April	4,340	450	1,900	113,000	A.
May	5,040	2,350	3,190	196,000	A.
June	3,110	1,400	1,960	116,000	A.
July	1,550	450	831	51,100	A.
August	400	275	315	19,400	B.
September	275	240	250	14,900	B.
October	735	240	320	19,700	B.
November	450	315	365	21,700	B.
December	.....	275	[a] 208	12,800	C.
The year	5,040	.....	901	646,000	

[a] Discharge estimated Jan. 1 to Mar. 12 and Dec. 22 to 31.

NOTE.—The means for January and February are only approximate.

SUN RIVER AT SUN RIVER, MONT.

This station, which is located at the highway bridge over Sun River, Mont., was established July 31, 1905, to obtain data for use in connection with irrigation projects. The records at this station do not show the total run-off from the drainage area above it, as

practically the entire valley above is irrigated from this stream. The greater part of the ordinary summer flow is utilized for irrigation. The principal tributaries are all above the station, South Fork of Sun River, Willow Creek, and Simms Creek being the most important.

The gage is a staff nailed securely to piling on the left bank just above the bridge.

The gage datum has not been changed since the station was established. The discharge is affected at times during the winter by ice. The gaging section at the bridge has been very poor since the high water of 1907, but good low-water measurements can be made by wading.

Discharge measurements of Sun River at Sun River, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 30	Raymond Richards	205	963	6.27	3,450
June 6	W. A. Lamb	145	601	4.85	1,900
July 9	J. C. Beebe	112	582	3.49	1,020
Aug. 11	M. E. McChristie	23	175	1.80	194
Sept. 3[a]	....do	116	108	2.38	309
Nov. 26	C. S. Heidel	96	735	2.80	571

[a] Made by wading 200 feet above gage.

Daily gage height, in feet, of Sun River at Sun River, Mont., for 1910.

[R. A. Lange, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.1	5.8	5.5	3.8	1.3	1.6	2.6	3.0	2.75
2	.....	3.15	5.5	5.4	4.0	1.0	1.8	2.45	3.1	2.8
3	.....	3.15	5.3	5.05	3.9	1.0	1.9	2.4	3.1	2.8
4	.....	3.1	5.0	5.0	4.2	1.0	2.4	2.5	3.0	2.8
5	.....	3.05	5.0	5.0	4.0	1.0	2.35	2.5	2.95	2.7
6	.....	3.1	5.5	5.0	3.9	1.0	2.3	2.6	2.9	2.7
7	.....	3.2	5.9	4.9	3.85	1.0	2.15	2.75	2.85	2.85
8	.....	3.3	6.9	4.9	3.75	1.0	2.1	2.7	2.8	2.8
9	.....	3.5	7.0	4.6	3.5	1.0	2.2	2.75	2.75	2.8
10	.....	3.8	7.0	4.5	3.3	1.5	2.15	2.75	2.75	2.8
11	.....	4.25	7.1	4.5	2.9	1.8	2.15	2.7	2.8	2.8
12	.....	4.3	6.6	4.5	2.7	1.3	2.3	2.75	3.0	2.8
13	3.65	5.0	6.5	4.95	2.8	1.2	2.4	2.75	3.0	2.8
14	3.6	5.0	6.2	4.8	2.85	1.05	2.25	2.75	3.1	2.8
15	3.6	4.75	6.2	4.9	2.8	1.0	2.15	2.7	3.1	2.8
16	3.8	4.35	6.15	4.9	2.8	1.0	2.4	2.8	3.0	2.8
17	3.8	4.1	6.0	4.6	2.8	.95	2.35	2.8	3.0	2.65
18	3.65	4.75	6.0	4.55	2.7	.9	2.4	2.8	3.05	2.6
19	3.6	5.0	6.0	4.55	2.65	1.0	2.3	2.8	2.8	2.6
20	3.65	5.05	5.5	4.5	2.5	1.5	2.4	2.85	2.8	2.7
21	3.65	5.7	5.2	4.5	2.0	1.0	2.4	2.85	2.8	2.65
22	3.9	5.55	5.2	4.5	2.0	1.0	2.55	2.95	2.75	2.6
23	4.0	5.45	5.6	4.5	2.0	1.0	2.55	2.7	2.65	2.65
24	4.2	5.45	5.8	4.3	2.0	1.0	2.5	2.65	3.0	2.75
25	3.9	6.2	6.2	4.7	2.0	1.2	2.5	2.65	2.85	2.8
26	3.5	6.8	6.5	4.7	1.9	1.15	2.55	2.85	2.8	2.85
27	3.3	6.8	7.0	4.0	1.9	1.15	2.55	3.0	2.8	2.85
28	3.3	6.9	6.75	3.9	1.8	1.15	2.55	3.0	2.8	2.8
29	3.25	6.7	6.2	3.8	1.8	1.1	2.6	2.45	2.8	2.9
30	3.2	6.3	6.0	.....	1.8	1.0	2.65	3.0	2.8	2.9
31	3.1	.....	5.8	.....	1.65	1.5	.....	3.1	.....	2.85

NOTE.—Ice probable during January, February, and first part of March.

Daily discharge, in second-feet, of Sun River at Sun River, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	660	2,940	2,610	1,100	130	160	410	610	485
2	.....	690	2,610	2,500	1,240	100	180	355	660	510
3	.....	690	2,390	2,130	1,170	100	190	340	660	510
4	.....	660	2,080	2,080	1,380	100	340	370	610	510
5	.....	635	2,080	2,080	1,240	100	325	370	585	460
6	.....	660	2,610	2,080	1,170	100	310	410	560	460
7	.....	720	3,050	1,980	1,140	100	265	485	535	535
8	.....	780	4,320	1,980	1,060	100	250	460	510	510
9	.....	900	4,460	1,710	900	100	280	485	485	510
10	.....	1,100	4,460	1,620	780	150	265	485	485	510
11	.....	1,420	4,600	1,620	560	180	265	460	510	510
12	.....	1,460	3,920	1,620	460	130	310	485	610	510
13	995	2,080	3,790	2,030	510	120	340	485	610	510
14	960	2,080	3,410	1,890	535	115	295	485	660	510
15	960	1,840	3,410	1,980	510	100	265	460	660	510
16	1,100	1,500	3,350	1,980	510	100	340	510	610	510
17	1,100	1,310	3,170	1,710	510	105	325	510	610	435
18	995	1,840	3,170	1,660	460	100	340	510	635	410
19	960	2,080	3,170	1,660	435	100	310	510	510	410
20	995	2,130	2,610	1,620	370	150	340	535	510	460
21	995	2,830	2,280	1,620	220	110	340	535	510	435
22	1,170	2,660	2,280	1,620	220	110	390	585	485	410
23	1,240	2,560	2,720	1,620	220	110	390	460	435	435
24	1,380	2,560	2,940	1,460	220	110	370	435	610	485
25	1,170	3,410	3,410	1,800	220	120	370	435	535	510
26	900	4,180	3,790	1,800	200	115	390	535	510	535
27	780	4,180	4,460	1,240	200	115	390	610	510	535
28	780	4,320	4,120	1,170	180	115	390	610	510	510
29	750	4,050	3,410	1,100	180	110	410	355	510	560
30	720	3,530	3,170	1,100	180	110	435	610	510	560
31	660	.....	2,940	.....	165	150	.....	660	.....	535

NOTE. These discharges are based on a rating curve that is well defined between 100 and 4,000 second-feet.

Monthly discharge of Sun River at Sun River, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	[a] 600	37,000	
February	.....	.....	[a] 550	30,500	
March	1,380	660	[b] 979	60,200	C.
April	4,320	635	1,980	118,000	A.
May	4,600	2,080	3,260	200,000	A.
June	2,610	1,100	1,770	105,000	A.
July	1,380	165	589	36,200	B.
August	180	100	115	7,070	B.
September	435	160	319	19,000	B.
October	660	340	482	29,600	B.
November	660	435	558	33,200	B.
December	560	410	493	30,300	B.
The period	.....	.....	974	706,000	

[a] Discharge estimated, Jan. 1 to Feb. 28. [b] Mean of 19 days taken as mean for month.

NOTE.—The means for January and February are only approximate.

WILLOW CREEK NEAR AUGUSTA, MONT.

Willow Creek rises on the eastern slopes of the Rocky Mountains in the northwestern part of Lewis and Clark County, Mont., and flows in a general northeasterly direction to its junction with North Fork of Sun River.

The gaging station, which is located at Jordan's ranch, just below the mouth of Little Willow Creek, about 7 miles northwest of Augusta,

Mont., was established June 8, 1905, to obtain run-off data for use in connection with the Sun River irrigation project. Willow Creek dam, work on which has been begun, will provide a reservoir with a capacity of 84,320 acre-feet.

Much of the valley land above the station is irrigated, the water being taken from this stream.

Conditions for obtaining accurate discharge data are excellent. No ice forms at this station as a large spring enters the creek just above the gage. A standard chain gage is located on the right bank, near the observer's footbridge. Measurements are made by wading at any convenient section. The datum of the gage has not been changed.

Discharge measurements of Willow Creek near Augusta, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec. ft.*
Apr. 29	Raymond Richards	22	31	1.73	41
May 26	do	17	11	1.10	16
July 12	J. C. Beebe	8	1.6	.48	1.8
Aug. 26	M. E. McChristie	2.5	.4	.45	*a* .8
Oct. 15	B. E. Jones	17	5.8	.74	4.8
Nov. 20	J. C. Beebe	12	8.1	.87	7.4

a Estimated.

NOTE.—Discharge measurements made by wading at various sections.

Daily gage height, in feet, of Willow Creek near Augusta, Mont., for 1910.

[Elizabeth Ireland, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.12	1.32	0.95	1.35	1.53	0.90	0.55	0.40	0.50	0.75	0.80	0.78
2	1.12	1.10	4.75	1.35	1.55	.90	.55	.40	.50	.75	.80	.78
3	1.10	1.10	5.80	1.35	1.55	.95	.55	.40	.50	.75	.80	.78
4	1.12	1.08	3.60	1.35	1.30	.95	.55	.40	.50	.75	.80	.78
5	1.05	1.08	2.70	1.30	1.30	.90	.50	.40	.50	.75	.80	.78
6	1.00	.98	2.05	1.30	1.30	.90	.50	.40	.50	.75	.80	.79
7	1.00	1.00	1.75	1.35	1.30	.90	.50	.40	.50	.75	.80	.79
8	1.00	1.00	1.60	1.35	1.30	.90	.50	.40	.50	.75	.80	.79
9	1.00	.98	1.45	1.35	1.25	.90	.50	.45	.50	.75	.80	.78
10	1.00	1.00	1.30	1.55	1.35	.85	.50	.45	.50	.75	.80	.78
11	1.00	1.00	1.45	1.55	1.30	.70	.50	.45	.50	.75	.80	.75
12	.98	1.00	1.65	1.55	1.30	.65	.50	.40	.50	.75	.80	.77
13	.95	1.00	1.45	1.65	1.25	.70	.50	.45	.55	.75	.80	.77
14	.95	.92	1.55	1.45	1.20	.70	.50	.45	.60	.75	.85	.80
15	.92	.92	1.45	1.45	1.20	.70	.50	.45	.60	.75	.85	.80
16	.92	.92	1.35	1.50	1.20	.70	.50	.45	.60	.75	.85	.80
17	.92	.95	1.30	1.50	1.20	.70	.25	.45	.60	.75	.85	.80
18	.92	.95	1.45	1.50	1.15	.65	.35	.40	.60	.85	.85	.80
19	.95	.95	1.45	1.55	1.15	.65	.35	.40	.60	.85	.85	.80
20	.98	.95	1.45	1.65	1.15	.65	.40	.45	.60	.85	.88	.80
21	.98	.92	1.55	1.70	1.15	.65	.40	.45	.60	.85	.90	.80
22	1.00	.90	1.65	1.55	1.15	.65	.40	.45	.70	.80	.85	.80
23	1.28	.90	1.65	1.55	1.15	.65	.40	.45	.70	.80	.90	.80
24	1.30	.90	1.55	1.65	1.10	.60	.40	.45	.70	.80	.90	.80
25	1.05	.90	1.25	1.65	1.05	.60	.35	.45	.70	.80	.85	.80
26	1.02	.90	1.4	1.60	1.10	.60	.40	.45	.70	.80	.82	.77
27	1.02	.90	1.35	1.70	1.10	.60	.40	.45	.70	.80	.78	.77
28	1.02	.90	1.25	1.72	1.05	.55	.40	.45	.75	.80	.78	.77
29	1.05	.....	1.35	1.60	1.05	.55	.40	.45	.75	.80	.78	.75
30	1.10	.....	1.35	1.55	1.05	.55	.40	.45	.75	.80	.78	.75
31	1.20	.....	1.30	.....	1.00	.....	.40	.45	.....	.80	.....	.72

Daily discharge, in second-feet, of Willow Creek near Augusta, Mont., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	15	23	10	24	32	8.8	2.4	0.8	1.7	5.6	6.5	6.1
2	15	14	203	24	32	8.8	2.4	.8	1.7	5.6	6.5	6.1
3	14	14	275	24	32	10	2.4	.8	1.7	5.6	6.5	6.1
4	15	13	135	24	22	10	2.4	.8	1.7	5.6	6.5	6.1
5	13	13	86	22	22	8.8	1.7	.8	1.7	5.6	6.5	6.1
6	11	11	55	22	22	8.8	1.7	.8	1.7	5.6	6.5	6.3
7	11	11	42	24	22	8.8	1.7	.8	1.7	5.6	6.5	6.3
8	11	11	35	24	22	8.8	1.7	.8	1.7	5.6	6.5	6.3
9	11	11	28	24	20	8.8	1.7	1.2	1.7	5.6	6.5	6.1
10	11	11	22	32	24	7.7	1.7	1.2	1.7	5.6	6.5	6.1
11	11	11	28	32	22	4.6	1.7	1.2	1.7	5.6	6.5	5.6
12	11	11	38	32	22	3.8	1.7	.8	1.7	5.6	6.5	5.9
13	10	11	28	38	20	4.6	1.7	1.2	2.4	5.6	6.5	5.9
14	10	9.3	32	28	18	4.6	1.7	1.2	3	5.6	7.6	6.5
15	9.3	9.3	28	28	18	4.6	1.7	1.2	3	5.6	7.6	6.5
16	9.3	9.3	24	30	18	4.6	1.7	1.2	3	5.6	7.6	6.5
17	9.3	10	22	30	18	4.6	.0	1.2	3	5.6	7.6	6.5
18	9.3	10	28	30	16	3.8	.5	.8	3	7.6	7.6	6.5
19	10	10	28	32	16	3.8	.5	.8	3	7.6	7.6	6.5
20	11	10	28	38	16	3.8	.8	1.2	3	7.6	8.3	6.5
21	11	9.3	32	40	16	3.8	.8	1.2	3	7.6	8.8	6.5
22	11	8.8	38	32	16	3.8	.8	1.2	4.6	6.5	7.6	6.5
23	21	8.8	38	32	16	3.8	.8	1.2	4.6	6.5	8.8	6.5
24	22	8.8	32	38	14	3	.8	1.2	4.6	6.5	8.8	6.5
25	13	8.8	20	38	13	3	.5	1.2	4.6	6.5	7.6	6.5
26	12	8.8	26	35	14	3	.8	1.2	4.6	6.5	7.0	5.9
27	12	8.8	24	40	14	3	.8	1.2	4.6	6.5	6.1	5.9
28	12	8.8	20	41	13	2.4	.8	1.2	5.6	6.5	6.1	5.9
29	13	.....	24	35	13	2.4	.8	1.2	5.6	6.5	6.1	5.6
30	14	.....	24	32	13	2.4	.8	1.2	5.6	6.5	6.1	5.2
31	18	.....	22	.....	11	.....	.8	1.2	.....	6.5	.....	5.0

NOTE.—These discharges are based on a rating curve that is well defined below 42 second-feet.

Monthly discharge of Willow Creek near Augusta, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	22	9.3	12.5	769	A.
February	23	8.8	10.8	600	A.
March	275	10	47.6	2,930	B.
April	41	22	30.8	1,830	A.
May	32	11	18.9	1,160	A.
June	10	2.4	5.42	323	A.
July	2.4	0	1.30	80	B.
August	1.2	.8	1.06	65	B.
September	5.6	1.7	3.04	181	B.
October	7.6	5.6	6.15	378	B.
November	8.8	6.1	7.05	420	B.
December	6.5	5.0	6.15	378	B.
The year	275	0	13.1	9,110	

SOUTH FORK OF SUN RIVER AT AUGUSTA, MONT.

This station, which is located at the highway bridge on the road from Augusta to Craig, Mont., about half a mile from Augusta, was established December 2, 1904, to obtain data for use in connection with the Sun River irrigation project.

Water is diverted to irrigate the valley lands, both above and below the stations. During dry seasons the entire summer flow is utilized.

The original gage was spiked to the cribwork of the right abutment on the downstream side of the bridge. On April 17, 1907, a new gage was established 100 yards above the bridge. This gage is spiked to a tree on the left bank and is set at a different datum. The new gage was used during 1907 and 1908. Records for 1909 and 1910 are referred to old gage. The gage heights are affected by ice during the winter.

Measurements in high water may be made from the highway bridge; in low water by wading.

Discharge measurements of South Fork of Sun River at Augusta, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 26	Raymond Richards	35	24	1.07	58
May 24	....do	17	16	.99	46
July 12[a]	M. E. McChristie	16	13	.69	12
Aug. 25	....do	2.5	.6	.33	[b] 1
Oct. 16[a]	B. E. Jones	14	12	.90	29
Nov. 21[a]	J. C. Beebe	26	22	.92	36

[a] Made by wading below bridge. [b] Estimated.

Daily gage height, in feet, of South Fork of Sun River at Augusta, Mont., for 1910.

[Richard Auchard, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.1	1.2	0.8	0.4	0.4	0.5	1.0	1.0	1.0
2	.....	1.1	1.15	.8	.5	.4	.5	1.0	1.0	1.0
3	.....	1.1	1.15	.8	.45	.4	.5	1.0	1.0	1.0
4	.....	1.1	1.15	.8	.45	.4	.5	1.0	1.0	1.0
5	.....	1.1	1.1	.8	.45	.3	.6	1.0	1.0	1.0
6	.....	1.1	1.1	.8	.5	.3	.6	1.0	1.0	.9
7	.....	1.1	1.1	.8	.5	.3	.6	1.0	1.0	.9
8	.....	1.15	1.1	.8	.5	.2	.6	1.0	1.0	.9
9	.....	1.15	1.1	.7	.5	.2	.6	.9	1.0	.9
10	.....	1.15	1.1	.7	.5	.3	.7	.9	1.0	.9
11	.....	1.2	1.1	.7	.6	.3	.7	.9	1.0	.9
12	.....	1.2	1.1	.7	.7	.3	.7	.9	1.0	1.0
13	1.2	1.2	1.1	.6	.5	.3	.7	.9	1.0	1.0
14	1.2	1.2	1.1	.5	.4	.3	.75	.9	1.0	1.0
15	1.15	1.2	1.1	.4	.4	.3	.75	.9	1.0	1.0
16	1.15	1.2	1.1	.4	.4	.3	.75	.9	1.0	1.0
17	1.15	1.2	1.1	.4	.4	.3	.75	.9	1.0	1.0
18	1.15	1.2	1.1	.4	.4	.3	.75	.9	1.0	1.0
19	1.15	1.2	1.1	.4	.3	.3	.75	.9	1.0	1.0
20	1.15	1.2	1.1	.4	.3	.3	.8	.9	1.0	1.0
21	1.2	1.15	1.1	.7	.3	.3	.8	.9	1.0	1.0
22	1.2	1.15	1.1	.7	.2	.3	.85	.9	1.0	1.0
23	1.2	1.15	1.1	.7	.2	.3	.9	.9	1.0	1.0
24	1.2	1.1	1.0	.7	.2	.3	.9	.9	.9	1.0
25	1.15	1.1	1.0	.7	.2	.3	.9	.9	.9	1.0
26	1.15	1.1	1.0	.7	.1	.3	.9	.9	.9	1.0
27	1.15	1.1	.9	.7	.1	.3	.9	1.0	1.0	1.0
28	1.15	1.1	.9	.7	−.2	.3	.9	1.0	1.0	1.4
29	1.1	1.1	.9	.6	.0	.3	.9	1.0	1.1	1.8
30	1.1	1.2	.8	.4	.0	.4	.9	1.0	2.0	2.1
31	1.1	.....	.8	.....	.5	.4	.....	1.0	.....	2.4

NOTE.—Ice, Jan. 1 to Mar. 12. The river was partly frozen over Nov. 29 and 30. Probably ice affected discharge to greater or less extent during December.

Daily discharge, in second-feet, of South Fork of Sun River at Augusta, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		63	81	21	2	2	4.2	46	46	46
2		63	72	21	4.2	2	4.2	46	46	46
3		63	72	21	3.1	2	4.2	46	46	46
4		63	72	21	3.1	2	4.2	46	46	46
5		63	63	21	3.1	.8	7.7	46	46	46
6		63	63	21	4.2	.8	7.7	46	46	32
7		63	63	21	4.2	.8	7.7	46	46	32
8		72	63	21	4.2	.3	7.7	46	46	32
9		72	63	13	4.2	.3	7.7	32	46	32
10		72	63	13	4.2	.8	13	32	46	32
11		81	63	13	7.7	.8	13	32	46	32
12		81	63	13	13	.8	13	32	46	46
13	81	81	63	7.7	4.2	.8	13	32	46	46
14	81	81	63	4.2	2	.8	17	32	46	46
15	72	81	63	2	2	.8	17	32	46	46
16	72	81	63	2	2	.8	17	32	46	46
17	72	81	63	2	2	.8	17	32	46	46
18	72	81	63	2	2	.8	17	32	46	46
19	72	81	63	2	.8	.8	17	32	46	46
20	72	81	63	2	.8	.8	21	32	46	46
21	81	72	63	13	.8	.8	21	32	46	46
22	81	72	63	13	.3	.8	26	32	46	46
23	81	72	63	13	.3	.8	32	32	46	46
24	81	63	46	13	.3	.8	32	32	32	46
25	72	63	46	13	.3	.8	32	32	32	46
26	72	63	46	13	.2	.8	32	32	32	46
27	72	63	32	13	.2	.8	32	46	46	46
28	72	63	32	13	0	.8	32	46	46	46
29	63	63	32	7.7	0	.8	32	46	46	46
30	63	81	21	2	0	2	32	46	46	46
31	63		21		4.2	2		46		46

NOTE.—These discharges are based on a curve that is well defined between 5 and 70 second-feet. Discharge estimated Nov. 29, 30, Dec. 28–31, because of ice conditions.

Monthly discharge of South Fork of Sun River at Augusta, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January			[a] 50	3,070	
February			[a] 50	2,780	
March	81	63	[a] 77.9	4,790	C.
April	81	63	71.4	4,250	A.
May	81	21	57.1	3,510	A.
June	21	2	11.9	708	B.
July	13	0	2.57	158	C.
August	2	.3	1.00	61	D.
September	32	4.2	17.8	1,060	A.
October	46	32	37.9	2,330	A.
November	46	32	44.6	2,650	B.
December	46	32	43.3	2,660	C.
The year			38.8	28,000	

[a] Discharge estimated Jan. 1 to Mar. 12 because of ice conditions.

NOTE.—The means for January and February are only approximate.

FORD CREEK NEAR AUGUSTA, MONT.

This station, which is located at the ranch of Joseph Ford, 16 miles west of Augusta, was established April 11, 1906, to obtain run-off data for use in connection with the Sun River irrigation project.

Ford and Smith creeks unite and form the South Fork of Sun River. Ford Creek has no tributaries. One small irrigation ditch diverts water from the creek above the gage.

The current is swift and the gage heights are but little affected by ice. Conditions of flow are changeable, requiring frequent measurements to properly define the rating curve.

The datum of the staff gage, located on the right bank of the stream near the observer's house, has remained unchanged. All measurements are made by wading.

Discharge measurements of Ford Creek near Augusta, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 28	Raymond Richards	25	23.5	1.65	58
May 27	do	24	20	1.49	37
July 14	J. C. Beebe	19	17	1.10	18
Aug. 27	M. E. McChristie	17	14	.98	13
Oct. 16	B. E. Jones	16	16	1.03	13
Nov. 21	J. C. Beebe	15	15	1.08	12
Do.	do	15	15	1.06	10

Daily gage height, in feet, of Ford Creek near Augusta, Mont., for 1910.

[Joseph Ford, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.15	1.05	1.05	1.25	1.55	1.45	1.20	1.05	1.05	1.05	1.00	1.05
2	1.15	1.05	1.45	1.25	1.55	1.45	1.20	1.05	1.05	1.05	1.00	1.05
3	1.15	1.05	1.60	1.25	1.62	1.45	1.15	1.05	1.05	1.05	1.00	1.05
4	1.15	1.05	1.65	1.25	1.62	1.45	1.15	1.05	1.05	1.05	1.00	1.05
5	1.15	1.05	1.30	1.25	1.62	1.45	1.15	1.05	1.05	1.05	1.00	1.05
6	1.15	1.05	1.15	1.25	1.62	1.35	1.15	1.05	1.05	1.05	1.00	1.05
7	1.15	1.05	1.10	1.25	1.62	1.35	1.15	1.05	1.05	1.05	1.00	1.05
8	1.15	1.05	1.05	1.25	1.62	1.35	1.15	1.05	1.05	1.05	1.00	1.05
9	1.15	1.05	1.05	1.45	1.55	1.35	1.15	1.05	1.05	1.05	1.00	1.05
10	1.15	1.05	1.05	1.45	1.55	1.35	1.15	1.05	.95	1.05	1.00	1.05
11	1.15	1.05	1.05	1.52	1.55	1.35	1.13	.95	.95	1.05	1.00	1.05
12	1.15	1.05	1.05	1.45	1.55	1.35	1.10	.95	.95	1.05	1.00	1.05
13	1.15	1.05	1.25	1.45	1.55	1.35	1.10	.95	.95	1.05	1.00	1.05
14	1.15	1.05	1.25	1.45	1.55	1.35	1.10	.95	.95	1.05	1.00	1.04
15	1.15	1.05	1.25	1.45	1.55	1.35	1.10	.95	.95	1.05	1.00	1.04
16	1.15	1.05	1.25	1.45	1.55	1.35	1.05	.95	1.15	1.05	1.00	1.04
17	1.15	1.05	1.25	1.45	1.55	1.35	1.05	.95	1.20	1.00	1.00	1.04
18	1.10	1.05	1.25	1.45	1.55	1.35	1.05	.95	1.05	1.00	1.00	1.05
19	1.05	1.05	1.25	1.55	1.55	1.35	1.05	.95	1.05	1.00	1.00	1.04
20	1.05	1.75	1.30	1.55	1.55	1.35	1.05	.95	1.05	1.00	1.00	1.05
21	1.05	1.75	1.35	1.55	1.55	1.30	1.05	.95	1.15	1.00	1.01	1.04
22	1.05	1.75	1.45	1.55	1.55	1.25	1.05	.95	1.05	1.00	1.04	1.04
23	1.05	1.75	1.45	1.62	1.55	1.25	1.05	.95	1.05	1.00	1.05	1.04
24	1.05	1.75	1.40	1.65	1.52	1.25	1.05	.95	1.05	1.00	1.05	1.04
25	1.05	1.75	1.40	1.65	1.52	1.25	1.05	.95	1.05	1.00	1.05	1.04
26	1.05	1.75	1.40	1.65	1.45	1.25	1.05	.95	1.05	1.00	1.07	1.05
27	1.05	1.75	1.40	1.72	1.45	1.22	1.05	.95	1.05	1.00	1.06	1.04
28	1.05	1.75	1.35	1.62	1.45	1.20	1.05	.95	1.05	1.00	1.05	1.04
29	1.05	.....	1.25	1.65	1.45	1.20	1.05	.95	1.05	1.00	1.06	1.04
30	1.05	.....	1.25	1.55	1.45	1.20	1.05	.95	1.05	1.00	1.08	1.04
31	1.15	.....	.....	.....	1.45	.....	1.05	.95	.....	1.00	.....	1.04

NOTE.—Gage height distorted by ice Feb. 20 to 28 and Mar. 2 to 7.

Daily discharge, in second-feet, of Ford Creek near Augusta, Mont., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	15	11	11	20	47	35	26	16	16	16	11	11
2	15	11	11	20	47	35	26	16	16	16	11	11
3	15	11	11	20	55	34	25	16	16	16	11	11
4	15	11	11	20	55	34	25	16	16	16	11	11
5	15	11	11	20	55	34	24	16	16	16	11	11
6	15	11	11	20	55	32	24	16	16	16	11	11
7	15	11	11	20	55	32	23	16	16	16	11	11
8	15	11	11	20	55	32	22	16	16	16	11	11
9	15	11	11	36	47	32	21	16	16	16	10	11
10	15	11	11	36	47	32	21	16	12	16	10	11
11	15	11	11	43	47	32	20	12	12	16	10	11
12	15	11	11	36	47	31	18	12	12	16	10	11
13	15	11	20	36	47	31	18	12	12	16	10	11
14	15	11	20	36	47	31	18	12	12	16	10	11
15	15	11	20	36	47	31	18	12	12	16	10	11
16	15	11	20	36	47	31	16	12	22	16	10	11
17	15	11	20	36	47	31	16	12	25	12	10	11
18	13	11	20	36	47	30	16	12	16	12	10	11
19	11	11	20	47	47	30	16	12	16	12	10	11
20	11	11	23	47	47	30	16	12	16	12	10	11
21	11	11	27	47	47	30	16	12	22	12	9.5	11
22	11	11	36	47	47	30	16	12	16	12	11	11
23	11	11	36	55	47	29	16	12	16	12	11	11
24	11	11	31	59	43	29	16	12	16	12	11	11
25	11	11	31	59	43	29	16	12	16	12	11	11
26	11	11	31	59	36	29	16	12	16	12	12	11
27	11	11	31	68	36	29	16	12	16	12	11	11
28	11	11	27	55	36	27	16	12	16	11	11	11
29	11	.....	20	59	36	27	16	12	16	11	11	11
30	11	.....	20	47	35	27	16	12	16	11	12	11
31	15	.....	20	.....	35	.....	16	12	.....	11	.....	11

NOTE.—These discharges are based on rating curves applicable as follows: Jan. 1 to May 27 and Nov. 21 to Dec. 31, well defined between 10 and 80 second-feet; May 28 to July 13 and Oct. 17 to Nov. 20, indirect method for shifting channels. July 14 to Oct. 16, fairly well defined between 12 and 20 second-feet. Discharges interpolated because of ice Feb. 20 to 28 and May 2 to 7.

Monthly discharge of Ford Creek near Augusta, Mont., for 1910.

[Drainage area, 18 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Run-off (total in acre-feet).	
January	15	11	13.4	0.744	0.86	824	B.
February	11	11	11.0	.611	.64	611	B.
March	36	11	19.5	1.08	1.24	1,200	B.
April	68	20	39.2	2.18	2.43	2,330	A.
May	55	35	46.1	2.56	2.95	2,830	A.
June	35	27	30.9	1.72	1.92	1,840	B.
July	26	16	18.9	1.05	1.21	1,160	B.
August	16	12	13.3	.739	.85	818	B.
September	25	12	15.9	.883	.99	946	B.
October	16	11	13.9	.772	.89	855	B.
November	12	9.5	10.6	.589	.66	631	B.
December	11	11	11.0	.611	.70	676	B.
The year	68	9.5	20.3	1.13	15.34	14,700	

SMITH CREEK NEAR AUGUSTA, MONT.

This station, which is located 1 mile above J. W. Nixon's ranch, 16 miles southwest of Augusta, Mont., was established April 14, 1906, to obtain run-off data for use in connection with the Sun River irrigation project.

The ordinary summer flow is practically all used for irrigation; but no water is diverted above the gaging station.

The gage is an inclined staff, fastened securely to a bowlder on the left bank just above the ford.

Discharge measurements are made by wading.

Discharge measurements of Smith Creek near Augusta, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 28	Raymond Richards	33	29	0.86	56
May 27	do	28	22	.68	34
July 14	J. C. Beebe	20	12	.46	14
Aug. 27	M. E. McChristie	11	9	.38	10
Oct. 16	B. E. Jones	22	12	.48	14
Nov. 21	J. C. Beebe	18	13	.50	13
22	do	19	14	.49	14

NOTE.—These measurements are made by wading at various sections.

Daily gage height, in feet, of Smith Creek near Augusta, Mont., for 1910.

[Mrs. J. W. Nixon, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.4	0.4	0.7	0.6	0.8	0.65	0.5	0.4	0.5	0.5	0.5	0.5
2	.4	.4	.8	.6	.8	.65	.5	.4	.45	.5	.5	.5
3	.4	.4	.75	.6	.8	.65	.5	.4	.45	.55	.5	.5
4	.4	.4	.75	.6	.8	.65	.5	.4	.45	.55	.5	.5
5	.4	.4	.7	.6	.75	.65	.5	.4	.45	.55	.5	.5
6	.4	.4	.65	.65	.75	.65	.5	.4	.45	.55	.5	.5
7	.4	.4	.6	.65	.75	.65	.5	.4	.5	.55	.5	.5
8	.4	.35	.5	.7	.75	.65	.5	.4	.5	.55	.5	.5
9	.4	.4	.45	.7	.75	.65	.5	.4	.5	.5	.5	.5
10	.4	.4	.45	.7	.8	.65	.5	.4	.5	.5	.5	.5
11	.4	.4	.45	.75	.8	.65	.5	.4	.55	.5	.5	.5
12	.4	.4	.45	.8	.8	.65	.5	.4	.55	.5	.5	.5
13	.4	.4	.45	.8	.8	.6	.45	.4	.55	.5	.5	.5
14	.4	.4	.5	.75	.8	.6	.45	.4	.5	.5	.5	.5
15	.4	.4	.5	.8	.8	.6	.45	.4	.5	.5	.5	.5
16	.4	.4	.55	.8	.75	.6	.45	.4	.5	.5	.5	.45
17	.4	.4	.7	.8	.75	.55	.45	.4	.7	.5	.5	.45
18	.4	.4	.75	.8	.7	.55	.4	.4	.7	.5	.5	.45
19	.4	.4	.8	.8	.7	.55	.4	.4	.65	.5	.5	.45
20	.4	.4	.9	.8	.7	.55	.4	.4	.65	.5	.5	.45
21	.4	.4	.9	.85	.7	.55	.4	.4	.6	.5	.5	.45
22	.4	.4	.9	.85	.7	.55	.4	.4	.6	.5	.5	.45
23	.45	.4	.85	.85	.7	.55	.4	.4	.6	.5	.5	.45
24	.45	.4	.85	.9	.7	.5	.4	.45	.6	.5	.5	.45
25	.45	.4	.75	.9	.7	.5	.4	.45	.6	.5	.5	.45
26	.45	.4	.75	.9	.7	.5	.4	.4	.55	.5	.5	.45
27	.4	.4	.7	.9	.7	.5	.4	.4	.5	.5	.5	.45
28	.4	.4	.7	.85	.7	.5	.4	.4	.5	.5	.5	.45
29	.4	.....	.65	.85	.7	.5	.4	.4	.45	.5	.5	.45
30	.4	.....	.6	.85	.7	.5	.4	.4	.45	.5	.5	.45
31	.4	.....	.6	.....	.65	.....	.4	.5	.....	.5	.....	.45

Daily discharge, in second-feet, of Smith Creek near Augusta, Mont., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10	10	36	25	48	30	16	10	16	16	15	14
2	10	10	48	25	48	30	16	10	13	16	15	14
3	10	10	42	25	48	30	16	10	13	20	15	14
4	10	10	42	25	48	30	16	10	13	20	15	14
5	10	10	36	25	42	30	16	10	13	20	15	14
6	10	10	30	30	42	30	16	10	13	20	15	14
7	10	10	25	30	42	30	16	10	16	20	15	14
8	10	8	16	36	42	30	16	10	16	20	15	14
9	10	10	13	36	42	30	16	10	16	16	15	14
10	10	10	13	36	48	30	16	10	16	16	15	14
11	10	10	13	42	48	30	16	10	20	16	15	14
12	10	10	13	48	48	30	16	10	20	16	15	14
13	10	10	13	48	48	25	13	10	20	16	15	14
14	10	10	16	42	48	25	13	10	16	16	15	14
15	10	10	16	48	48	25	13	10	16	16	15	14
16	10	10	20	48	42	25	13	10	16	16	15	13
17	10	10	36	48	42	20	13	10	36	15	15	13
18	10	10	42	48	36	20	10	10	36	15	15	13
19	10	10	48	48	36	20	10	10	30	15	15	13
20	10	10	63	48	36	20	10	10	30	15	15	13
21	10	10	63	56	36	20	10	10	25	15	14	13
22	10	10	63	56	36	20	10	10	25	15	14	13
23	13	10	56	56	36	20	10	10	25	15	14	13
24	13	10	56	63	36	16	10	13	25	15	14	13
25	13	10	42	63	36	16	10	13	25	15	14	13
26	13	10	42	63	36	16	10	10	20	15	14	13
27	10	10	36	63	36	16	10	10	16	15	14	13
28	10	10	36	56	36	16	10	10	16	15	14	13
29	10	.....	30	56	36	16	10	10	13	15	14	13
30	10	.....	25	56	36	16	10	10	13	15	14	13
31	10	.....	25	.....	30	.....	10	16	.....	15	.....	13

NOTE.—These discharges are based on rating curves applicable as follows: Jan. 1 to Oct. 16, curve well defined; Oct. 17 to Nov. 20, indirect method for shifting channel; Nov. 21 to Dec. 31, rating curve poorly defined.

Monthly discharge of Smith Creek near Augusta, Mont., for 1910.

[Drainage area, 26 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	13	10	10.4	0.400	0.461	640	B.
February	10	8	9.93	.382	.398	551	B.
March	63	13	34.0	1.31	1.51	2,090	A.
April	63	25	45.0	1.73	1.93	2,680	A.
May	48	30	41.0	1.58	1.82	2,520	A.
June	30	16	23.7	.912	1.02	1,410	A.
July	16	10	12.8	.492	.567	787	A.
August	16	10	10.2	.392	.452	627	B.
September	36	13	19.6	.753	.840	1,170	A.
October	20	15	16.3	.627	.723	1,000	B.
November	15	14	14.7	.566	.632	875	B.
December	14	13	13.5	.519	.598	830	B.
The year	63	8	21	.805	10.95	15,200	

MARIAS RIVER BASIN.

DESCRIPTION.

The headwaters of Marias River rise on the eastern slope of the main divide of the Rocky Mountains, at an elevation of over 8,000 feet above sea level, and flow eastward through a region of elevated plains and prairies. Marias River proper is formed by the union of Cutbank and Two Medicine rivers, which meet at the eastern boundary of the Blackfeet Indian Reservation. From this junction to the Missouri, which it enters 14 miles below Fort Benton, its length is about 110 miles and its fall does not exceed 5 feet per mile. Its principal tributaries are Willow and Cottonwood creeks, which enter from the north, and Teton River, which comes in from the south.

The general altitude of this country is 3,000 to 4,000 feet above sea level, the plains rising by gentle terraces toward the mountains to elevations of about 5,000 feet. Grass is abundant and the region is devoted to grazing. Considerable spruce and pine timber is found at the headwaters in the mountains, but the remainder of the basin is bare except for fringes and small groves along the streams.

The mean annual rainfall ranges from about 60 inches in the mountains to 12 inches near the mouth of the river, the average for the plains section being about 16 inches. The streams are icebound from December until early in March, and this is the season of least flow.

Irrigation has been practiced to a slight extent for a number of years in the valleys of the tributaries, and three large irrigation projects are now under construction. One is being constructed by the United States Reclamation Service, and the other two under the Carey Act. Altogether about 450,000 acres will be reclaimed. The basin affords a number of excellent reservoir sites, which will be utilized in storing the flood waters of the upper tributaries from which the principal water supply for these projects will come.

The great fall and the abundant water supply of the upper tributaries of Marias River also afford favorable conditions for water-power development.

Run-off records in this basin extend back to 1902. The wettest year since that time was 1903 and the driest was 1905.

TWO MEDICINE RIVER AT FAMILY, MONT.

This station, which is located at the Holy Family Mission, 16 miles southeast of Browning, Mont, and about 6 miles above the mouth of Badger Creek, the nearest tributary, was established April, 1907, to determine the amount of water available for irrigation.

The United States Reclamation Service has under consideration a project which will use about 200 second-feet of water for irrigating

land north of the stream for the Blackfeet Indians. The water will be diverted near the mouth of Little Badger Creek, a small tributary entering from the south above the station. A storage reservoir will be built at Two Medicine Lake, near the headwaters of the stream, to augment the low-water flow. The only diversion from this stream at present is that made by a ditch which supplies water for about 100 acres of land on the farm at the Holy Family Mission. It heads about 2 miles above the gage.

A standard chain gage is located on the east bank of the stream directly back of the mission buildings. High-water measurements must be made from the old wagon bridge located about 3 miles above the bridge. Wading measurements are made in low water at a section near the gage.

The datum of the gage was lowered 0.95 foot July 21, 1908.

The results are good at this station, except during the winter months, when they are affected by ice.

Discharge measurements of Two Medicine River at Family, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 23	W. A. Lamb	59	309	3.40	964
Apr. 25	M. E. McChristie	59	326	3.75	1,240
26	W. A. Lamb	59	344	3.92	1,490
May 18	do	59	210	3.12	812
June 16	M. E. McChristie	68	195	2.93	666
Aug. 4[a]	do	57	42	1.64	95
Sept. 10[a]	do	58	46	1.70	120
Nov. 22	W. A. Lamb	60	178	2.33	358

[a] Made by wading.

Daily gage height, in feet, of Two Medicine River at Family, Mont., for 1910.

[Otto Johnson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		2.3	3.5	3.45	2.35	1.65	1.5	2.15	2.10
2		2.3	3.3	3.45	2.35	1.65	1.7	2.15	2.08
3		2.2	3.05	3.35	2.3	1.65	1.8	2.15	2.09
4		2.2	3.0	3.25	2.3	1.65	1.7	2.6	2.05
5		2.2	2.9	3.0	2.2	1.6	1.7	2.5	2.00
6		2.4	3.05	2.9	2.15	1.6	1.7	2.5	1.95
7		2.6	3.3	2.95	2.1	1.6	1.7	2.5	1.90
8		2.6	3.65	3.1	2.05	1.6	1.7	2.85	2.00
9		3.0	3.95	2.95	2.05	1.6	1.7	2.75	2.23
10		3.6	4.0	2.9	2.0	1.6	1.7	2.78	2.75
11		3.6	3.9	2.9	2.0	1.6	1.85	2.7	2.80
12		3.5	3.8	3.0	2.0	1.55	1.81	2.6	2.68
13		3.7	3.6	3.05	1.9	1.55	1.8	2.5	2.50
14		3.3	3.45	3.0	1.9	1.55	1.8	2.4	2.40
15		3.1	3.45	2.95	1.85	1.55	1.8	2.3	2.33
16		3.0	3.3	2.95	1.85	1.55	1.8	2.22	2.11
17		3.1	3.25	2.95	1.85	1.55	1.8	2.15	2.16
18		3.3	3.15	2.85	1.85	1.55	1.81	2.15	2.16
19		3.2	3.2	2.8	1.85	1.55	1.8	2.1	1.96
20	3.0	3.8	3.25	2.7	1.85	1.5	1.8	2.05	1.90

Daily gage height, in feet, of Two Medicine River at Family, Mont., for 1910—Contd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
21	3.2	3.7	3.2	2.65	1.8	1.5	1.8	.....	2.00
22	3.6	3.6	3.1	2.6	1.8	1.5	1.85	.....	2.24
23	3.7	3.4	3.15	2.55	1.75	1.5	1.8	.....	2.15
24	3.0	3.6	3.3	2.45	1.7	1.6	1.8	.....	2.05
25	2.9	3.9	3.5	2.4	1.7	1.5	1.9	.....	2.15
26	2.8	3.9	3.7	2.35	1.7	1.5	1.9	.....	2.25
27	2.6	4.3	3.65	2.3	1.7	1.5	1.9	.....	.....
28	2.5	4.3	3.55	2.35	1.7	1.5	1.9	.....	.....
29	2.6	4.0	3.5	2.35	1.7	1.5	1.9	.....	.....
30	2.4	3.7	3.45	2.4	1.7	1.5	1.9	.....	.....
31	2.3	.....	3.45	.....	1.65	1.5	.....	.....	.....

NOTE.—Ice conditions Jan. 1 to about Mar. 19 and Nov. 27 to Dec. 31.

Daily discharge, in second-feet, of Two Medicine River at Family, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	330	1,080	1,040	355	103	75	265	245
2	.....	330	920	1,040	355	103	114	265	237
3	.....	285	748	958	330	103	140	265	241
4	.....	285	715	885	330	103	114	485	225
5	.....	285	655	715	285	92	114	430	205
6	.....	380	748	655	265	92	114	430	188
7	.....	485	920	685	245	92	114	430	171
8	.....	485	1,200	780	225	92	114	625	205
9	.....	715	1,460	685	225	92	114	568	299
10	.....	1,160	1,500	655	205	92	114	584	568
11	.....	1,160	1,410	655	205	92	158	540	595
12	.....	1,080	1,320	715	205	84	143	485	529
13	.....	1,240	1,160	748	171	84	140	430	430
14	.....	920	1,040	715	171	84	140	380	380
15	.....	780	1,040	685	158	84	140	330	345
16	.....	715	920	685	158	84	140	294	249
17	.....	780	885	685	158	84	140	265	269
18	.....	920	815	625	158	84	143	265	269
19	.....	850	850	595	158	84	140	245	191
20	715	1,320	885	540	158	75	140	225	171
21	850	1,240	850	512	140	75	140	225	205
22	1,160	1,160	780	485	140	75	158	225	303
23	1,240	995	815	458	127	75	140	230	265
24	715	1,160	920	405	114	92	140	230	225
25	655	1,410	1,080	380	114	75	171	235	265
26	595	1,410	1,240	355	114	75	171	235	308
27	485	1,790	1,200	330	114	75	171	235	.....
28	430	1,790	1,120	355	114	75	171	240	.....
29	485	1,500	1,080	355	114	75	171	240	.....
30	380	1,240	1,040	380	114	75	171	245	.....
31	330	.....	1,040	.....	103	75	.....	245	.....

NOTE.—These discharges are based on a rating curve well defined between 140 and 1,600 second-feet. Discharges estimated Oct. 21 to 31.

Monthly discharge of Two Medicine River at Family, Mont., for 1910.

[Drainage area, 368 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	[a] 75	0.204	0.24	4,610	D.
February	.....	.....	[a] 75	.204	.21	4,170	D.
March	1,160	.....	[a] 275	.747	.86	16,900	D.
April	1,790	285	940	2.55	2.84	55,900	A.
May	1,500	655	1,010	2.74	3.16	62,100	A.
June	1,040	330	629	1.71	1.91	37,400	A.
July	355	103	188	.511	.59	11,600	A.
August	103	75	85.4	.232	.27	5,250	B.
September	158	75	138	.375	.42	8,210	A.
October	625	225	335	.910	1.05	20,600	B.
November	595	171	[a] 292	.793	.88	17,400	A.
December	.....	.....	[a] 100	.272	.31	6,150	D.
The year	1,790	.....	345	.938	12.74	250,000	

[a] Discharge estimated because of ice Jan. 1 to Mar. 19 and Nov. 27 to Dec. 31.

NOTE.—The means for January, February, March, and December are only approximate.

BADGER CREEK NEAR FAMILY, MONT.

Badger Creek is tributary to Two Medicine Creek.

This station, which is located near the road crossing 4 miles east of Family, Mont., was established April 20, 1907, to determine the amount of water available for irrigation. The United States Reclamation Service proposes to divert the natural flow of the stream to irrigate land in the eastern part of the Blackfeet Indian Reservation and north of Birch Creek.

The gage and bench marks were washed out in June, 1908, and a new gage was established July 22, 1908, about 400 feet farther upstream and at a different datum. As the bench mark was destroyed, the relation between the two gages could not be determined. The gage was again washed out May 25, 1909, and was reset at a different datum some 4 miles below the cable section and just below the old Piegan Mission crossing. High-water measurements are made from a cable. Low-water measurements can be made by wading at the cable section.

The stream at the gage flows in two channels at both medium and low stages. At high stages there are several channels. High-water measurements are, therefore, only fair. The low records, however, are good.

No records of gage heights were obtained during January, February, and first part of March, owing to lack of funds.

Discharge measurements of Badger Creek near Family, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 23	W. A. Lamb	57	166	4.64	466
25	do	60	188	5.02	702
May 20	do	58	170	4.73	486
June 15	M. E. McChristie	57	151	4.43	319
Aug. 3[a]	do	73	115	3.80	142
Sept. 10[b]	do	90	83	3.88	154
Nov. 22[b]	W. A. Lamb	78	81	4.06	205

[a] Made by wading above cable. [b] Made by wading above gage.

Daily gage height, in feet, of Badger Creek near Family, Mont., for 1910.

[Oliver J. Racine, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.80	4.62	4.85	.....	3.80	3.88	3.95	4.08	4.32
2	.....	3.90	4.65	4.72	.....	3.80	3.90	3.98	4.00	4.40
3	.....	3.80	4.60	4.65	4.10	3.80	3.92	3.98	4.00	4.28
4	.....	3.80	4.58	4.52	4.08	3.80	3.92	4.10	4.00	4.48
5	.....	3.88	4.75	4.52	4.15	3.80	3.90	4.15	4.00	4.48
6	.....	3.72	4.90	4.48	4.05	3.80	3.88	4.15	4.05	4.48
7	.....	3.92	4.90	4.50	4.05	3.78	3.88	4.18	4.08	4.50
8	.....	3.88	4.92	4.55	4.02	3.78	3.85	4.18	4.10	4.52
9	6.20	3.98	5.05	4.50	4.00	3.78	3.88	4.28	4.12	4.55
10	6.38	4.10	5.15	4.45	4.10	3.80	3.90	4.25	4.10	4.55
11	6.30	4.30	4.98	4.40	3.92	3.75	3.88	4.22	4.08	4.55
12	6.30	4.50	4.92	4.42	3.98	3.75	3.88	4.18	4.05	4.60
13	3.90	4.52	4.90	4.42	3.95	3.75	3.88	4.15	4.05	4.52
14	3.82	4.50	4.85	4.42	3.92	3.75	3.88	4.12	4.08	4.05
15	3.85	4.52	4.85	4.42	4.05	3.80	3.88	4.08	4.05	4.02
16	3.78	4.28	4.75	4.42	3.92	3.75	3.88	4.08	4.05	4.00
17	3.82	4.40	4.68	4.42	3.92	3.75	3.88	3.90	4.00	3.95
18	3.75	4.38	4.82	4.30	3.92	3.75	3.88	3.92	.....	3.92
19	3.80	4.58	4.80	4.28	3.88	3.75	3.88	3.92	.....	3.95
20	3.95	4.90	4.72	4.30	3.98	3.78	3.88	3.92	.....	3.98
21	3.90	4.70	4.60	4.22	3.88	3.72	3.92	3.92	4.05	3.98
22	4.15	4.70	4.62	4.25	3.85	3.72	3.95	3.92	4.00	4.00
23	4.10	4.58	4.70	4.18	3.85	3.75	3.98	3.98	4.05	4.00
24	4.05	4.70	4.88	4.15	3.85	3.75	3.95	4.02	4.08	4.05
25	4.05	5.00	5.00	4.18	3.95	3.82	3.95	4.38	4.10	4.08
26	3.92	5.00	4.95	.....	3.82	3.80	3.95	4.28	4.12	4.08
27	4.00	5.18	4.90	.....	3.85	3.75	3.95	4.22	4.18	4.10
28	3.85	5.15	4.78	.....	3.85	3.75	3.92	4.18	4.22	4.12
29	3.82	5.05	4.72	.....	3.82	3.75	3.98	4.15	4.25	4.10
30	3.90	4.90	4.85	.....	3.80	3.82	3.95	4.12	4.28	4.12
31	3.82	.....	4.82	.....	3.90	3.85	.....	4.10	.....	4.18

NOTE.—Probably affected by ice during part of period Jan. 1 to Mar. 12 and Nov. 26 to Dec. 31.

Daily discharge, in second-feet, of Badger Creek near Family, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	141	429	577	210	141	156	171	203
2	.....	160	447	490	210	141	160	178	182
3	.....	141	417	447	208	141	164	178	182
4	.....	141	406	374	203	141	164	208	182
5	.....	156	510	374	224	141	160	224	182
6	.....	127	612	354	195	141	156	224	195
7	.....	164	612	363	195	138	156	233	203
8	.....	156	627	390	187	138	150	233	208
9	.....	178	727	363	182	138	156	268	214
10	.....	208	810	340	208	141	160	277	208

Daily discharge, in second-feet, of Badger Creek near Family, Mont., for 1910—Cont'd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	.....	275	672	316	164	132	156	246	203
12	.....	363	627	325	178	132	156	233	195
13	160	374	612	325	171	132	156	224	195
14	145	363	575	325	164	132	156	214	203
15	150	374	575	325	195	141	156	203	195
16	138	268	410	325	164	132	156	203	195
17	145	316	465	325	164	132	156	160	182
18	132	308	556	275	164	132	156	164	187
19	141	406	542	268	156	132	156	164	188
20	172	612	490	275	178	138	156	164	190
21	160	477	417	246	156	127	164	164	195
22	224	477	429	277	150	127	171	164	182
23	208	406	477	233	150	132	178	178	195
24	195	477	598	224	150	132	171	187	203
25	195	687	687	233	171	145	171	308	208
26	164	687	650	230	145	141	171	268	.....
27	182	835	612	225	150	132	171	246	.....
28	150	810	527	220	150	132	164	233	.....
29	145	727	490	215	145	132	178	224	.....
30	160	612	577	215	141	145	171	214	.....
31	145	.....	556	.....	160	150	.....	208	.....

NOTE.—These discharges are based on a curve that is well defined between 100 and 850 second-feet. Discharges June 26 to July 2 and Nov. 18 to 20 interpolated.

Monthly discharge of Badger Creek near Family, Mont., for 1910.

[Drainage area, 224 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	[a]100	0.446	0.51	6,150	D.
February	.....	.....	[a]75	.335	.35	4,160	D.
March	224	132	[a]162	.723	.83	9,960	B.
April	835	127	381	1.70	1.90	22,700	A.
May	810	406	553	2.47	2.85	34,000	A.
June	577	[b]215	316	1.41	1.57	18,800	A.
July	224	141	174	.777	.90	10,700	A.
August	150	127	136	.607	.70	8,400	A.
September	178	150	162	.723	.81	9,640	A.
October	308	160	212	.946	1.09	13,000	A.
November	277	182	199	.888	.99	11,800	A.
December	.....	.....	[a]175	.781	.90	10,800	D.
The year	835	.....	220	.982	13.40	175,000	

[a] Discharge estimated Jan. 1 to Mar. 12 and Nov. 26 to Dec. 31. [b] Estimated value.

NOTE.—Means for January and February are only approximate.

CUTBANK CREEK AT CUTBANK, MONT.

This station, which is located half a mile southwest of Cutbank, one-fourth mile below the Great Northern Railway bridge, and 12 miles above the mouth of Two Medicine, was established August 4, 1905, to obtain data for use in connection with irrigation projects under consideration by the United States Reclamation Service.

The intake of the Great Northern Railway's pumping station is located a hundred yards above the gage. The average quantity pumped is about 14,000 gallons an hour for 18 hours a day—equivalent to a continuous flow of 0.4 second-foot.

The datum of the gage has not been changed since the station was established. The records during the winter months are somewhat affected by ice. The results taken as a whole can be considered as good.

Measurements in high water are made from a cable. The chain gage used at this station is located on the left bank about 100 yards above the cable.

Discharge measurements of Cutbank Creek at Cutbank, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 26	W. A. Lamb	105	142	3.65	404
May 21	do	112	146	3.66	413
June 21	do	105	112	3.41	253
Aug. 11 [a]	C. S. Heidel	44	23	2.80	39
Sept. 25	M. E. McChristie	97	63	3.10	108
Nov. 28 [b]	B. E. Jones	58	80	3.00	28

[a] Made by wading below cable.
[b] Creek frozen over. Thickness of ice at measuring section ranged from 0.2 to 0.5 foot.

Daily gage height, in feet, of Cutbank Creek at Cutbank, Mont., for 1910.

[Conrad Peters, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.2	3.7	3.8	3.3	2.9	2.8	3.05	3.25	3.2
2	.....	3.2	3.6	3.8	3.3	2.9	2.9	3.15	3.2	3.3
3	.....	3.2	3.6	3.75	3.3	2.9	2.9	3.35	3.2	3.4
4	.....	3.2	3.5	3.7	3.3	2.9	2.9	3.4	3.15	3.4
5	.....	3.2	3.5	3.6	3.3	2.9	2.9	3.4	3.15	3.3
6	.....	3.2	3.5	3.6	3.25	2.9	2.9	3.4	3.15	3.2
7	.....	3.2	3.5	3.6	3.2	2.8	2.9	3.4	3.1	3.2
8	3.9	3.2	3.65	3.75	3.2	2.8	2.9	3.4	3.1	3.2
9	3.9	3.3	3.75	3.8	3.15	2.8	2.9	3.45	3.15	3.2
10	3.8	3.4	3.9	3.7	3.1	2.8	2.9	3.5	3.2	3.2
11	3.75	3.4	3.9	3.6	3.1	2.8	2.9	3.5	3.2	3.2
12	3.7	3.45	3.8	3.6	3.1	2.8	2.9	3.45	3.1	3.2
13	3.75	3.5	3.8	3.6	3.1	2.8	2.9	3.45	3.25	3.2
14	3.95	3.5	3.75	3.6	3.1	2.8	2.9	3.45	3.4	3.2
15	4.0	3.45	3.7	3.6	3.1	2.8	2.9	3.3	3.3	3.2
16	3.95	3.4	3.7	3.6	3.1	2.8	2.9	3.3	3.3	3.2
17	3.9	3.4	3.7	3.6	3.1	2.8	2.9	3.3	3.2	3.25
18	3.8	3.4	3.6	3.6	3.1	2.8	3.0	3.25	3.2	3.2
19	3.5	3.45	3.6	3.6	3.1	2.8	3.0	3.25	3.15	3.2
20	3.4	3.55	3.6	3.5	3.1	2.8	3.0	3.2	3.2	3.1
21	3.4	3.6	3.6	3.5	3.0	2.8	3.0	3.2	3.2	3.1
22	3.4	3.6	3.7	3.5	3.0	2.8	3.1	3.2	3.2	3.05
23	3.4	3.6	3.7	3.5	3.0	2.8	3.1	3.2	3.2	3.0
24	3.4	3.5	3.7	3.5	3.0	2.8	3.1	3.15	3.2	2.9
25	3.4	3.5	3.75	3.5	3.0	2.8	3.1	3.1	3.2	2.95
26	3.4	3.65	3.8	3.4	3.0	2.8	3.1	3.15	3.1	3.0
27	3.3	3.75	3.8	3.35	2.9	2.8	3.1	3.5	3.1	3.1
28	3.3	3.9	3.8	3.3	2.9	2.8	3.1	3.4	3.05	3.1
29	3.2	3.85	3.7	3.4	2.9	2.8	3.1	3.35	3.1	3.2
30	3.2	3.8	3.7	3.4	2.9	2.8	3.1	3.3	3.2	3.2
31	3.2	.....	3.7	.....	2.9	2.8	.....	3.3	.....	3.2

NOTE.—Ice probably existed Jan. 1 to about Mar. 7 and after Nov. 20.

Daily discharge, in second-feet, of Cutbank Creek at Cutbank, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	148	445	543	194	57	39	95	171
2	.....	148	367	543	194	57	57	129	148
3	.....	148	367	494	194	57	57	220	148
4	.....	148	303	445	194	57	57	246	129
5	.....	148	303	367	194	57	57	246	129
6	.....	148	303	367	171	57	57	246	129
7	.....	148	303	367	148	39	57	246	110
8	650	148	406	494	148	39	57	246	110
9	650	194	494	543	129	39	57	274	129
10	543	246	650	445	110	39	57	303	148
11	494	246	650	367	110	39	57	303	148
12	445	274	543	367	110	39	57	274	110
13	494	303	543	367	110	39	57	274	171
14	711	303	494	367	110	39	57	274	246
15	772	274	445	367	110	39	57	194	194
16	711	246	445	367	110	39	57	194	194
17	650	246	445	367	110	39	57	194	148
18	543	246	367	367	110	39	80	171	148
19	303	274	367	367	110	39	80	171	129
20	246	335	367	303	110	39	80	148	.....
21	246	367	367	303	80	39	80	148	.....
22	246	367	445	303	80	39	110	148	.....
23	246	367	445	303	80	39	110	148	.....
24	246	303	445	303	80	39	110	129	.....
25	246	303	494	303	80	39	110	110	.....
26	246	406	543	246	80	39	110	129	.....
27	194	494	543	220	57	39	110	303	.....
28	194	650	543	194	57	39	110	246	.....
29	148	596	445	246	57	39	110	220	.....
30	148	543	445	246	57	39	110	194	.....
31	148	.....	445	.....	57	39	.....	194	.....

NOTE.—These discharges are based on a well-defined curve between 30 and 1,400 second-feet.

Monthly discharge of Cutbank Creek at Cutbank, Mont., for 1910.

[Drainage area, 971 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	[a]150	0.154	0.18	9,220	
February	.....	.....	[a]150	.154	.16	8,330	
March	772	148	[a]355	.366	.42	21,800	B.
April	650	148	292	.301	.34	17,400	A.
May	650	303	444	.457	.53	27,300	A.
June	543	194	363	.374	.42	21,600	A.
July	194	57	114	.118	.14	7,010	A.
August	57	39	42.5	.044	.05	2,610	A.
September	110	39	75.4	.078	.09	4,490	A.
October	303	95	207	.213	.25	12,700	A.
November	246	.....	[a]117	.120	.13	6,960	C.
December	.....	.....	[a]35	.036	.04	2,150	
The year	.....	.....	196	.202	2.75	142,000	

[a] Discharge Jan. 1 to Mar. 7 and Nov. 20 to Dec. 31 estimated for ice effect.

NOTE.—The means for January, February, and December are only approximate.

BIRCH CREEK NEAR DUPUYER, MONT.

This station, which is located at Shields ranch, 12 miles northwest of Dupuyer, Mont., and about 25 miles from its junction with Two Medicine River, was established July 25, 1907, to determine the amount of water available for irrigation projects on the Blackfeet Indian Reservation.

No storage is used on this stream, but a number of ditches divert water for irrigation. The largest of these, owned by the Conrad Investment Co., diverts water about half a mile below the station.

The gage datum remained the same from the time the station was established until the high water of June, 1908, when the gage was washed away and the channel changed. A temporary staff gage was put in July 23, 1908, about 200 feet below the original gage. This gage was used until October 1, 1908, when a permanent chain gage was established one-fourth mile above. Measurements are made from a car and cable located three-fourths of a mile downstream from the gage. By wading just below the cable section better low-water results may be obtained.

Discharge measurements of Birch Creek near Dupuyer, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 24	M. E. McChristie	73	101	5.35	279
May 19	W. A. Lamb	72	98	5.30	263
June 16	M. E. McChristie	70	80	5.00	195
Aug. 4[a]	do	49	47	4.41	85
Sept. 16[b]	C. S. Heidel	43	47	4.70	125
Nov. 30[c]	do	34	38	4.63	81

[a] Made by wading 125 feet below cable.
[b] Made by wading at gage.
[c] Ice. Gage read through hole cut in ice.

Daily gage height, in feet, of Birch Creek near Dupuyer, Mont., for 1910.

[Fred A. Nelson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		4.59	5.33	5.38	4.63	4.43	4.65	4.66	4.61
2		4.59	5.25	5.36	4.61	4.42	4.58	4.68	4.62
3		4.54	5.18	5.22	4.61	4.42	4.48	4.70	4.63
4		4.52	5.15	5.13	4.60	4.42	4.45	4.74	4.61
5		4.53	5.04	5.12	4.58	4.41	4.48	4.74	4.60
6		4.56	5.04	5.13	4.55	4.41	4.49	4.76	4.58
7		4.83	5.44	5.14	4.52	4.41	4.48	4.78	4.57
8		4.87	5.67	5.12	4.50	4.40	4.48	4.80	4.58
9		4.93	5.87	5.08	4.50	4.40	4.45	4.81	4.63
10		4.98	5.82	5.02	4.50	4.39	4.62	4.76	4.68
11		5.14	5.73	5.00	4.49	4.39	4.60	4.75	4.71
12		5.17	5.62	5.06	4.49	4.39	4.58	4.70	4.73
13	4.45	5.18	5.48	5.10	4.48	4.38	4.56	4.71	4.72
14	4.47	5.02	5.44	5.00	4.48	4.38	4.55	4.68	4.68
15	4.50	5.00	5.42	5.12	4.47	4.37	4.65	4.66	4.66

Daily gage height, in feet, of Birch Creek near Dupuyer, Mont., for 1910—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	4.52	4.95	5.25	5.03	4.46	4.37	4.70	4.65	4.65
17	4.50	4.90	5.23	5.02	4.46	4.36	4.69	4.63	4.64
18	4.60	5.41	5.42	5.00	4.46	4.35	4.62	4.63	4.63
19	4.70	5.44	5.28	4.98	4.45	4.33	4.58	4.62	4.63
20	4.71	5.37	5.24	4.99	.....	4.31	4.60	4.62	4.62
21	4.90	5.34	5.21	4.92	.....	4.29	4.58	4.60	4.62
22	5.00	5.17	5.13	4.86	.....	4.28	4.55	4.58	4.62
23	5.01	5.37	5.12	4.87	.....	4.28	4.65	4.56	4.61
24	4.98	5.57	5.38	4.84	.....	4.40	4.73	4.54	4.61
25	4.93	5.76	5.56	4.83	.....	4.35	4.68	4.73	4.60
26	4.83	5.78	5.62	4.81	.....	4.34	4.65	4.76	4.58
27	4.73	5.80	5.41	4.80	4.44	4.33	4.63	4.70	4.68
28	4.67	5.75	5.28	4.78	4.44	4.33	4.68	4.68	4.75
29	4.66	5.67	5.24	4.72	4.44	4.33	4.70	4.66	4.75
30	4.65	5.40	5.42	4.67	4.43	4.33	4.68	4.67	4.63
31	4.58	.....	5.35	.....	4.43	4.32	.....	4.65	.....

NOTE.—Ice Jan. 1 to about Mar. 13, and Nov. 27 to Dec. 31.

Daily discharge, in second-feet, of Birch Creek near Dupuyer, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	110	272	286	117	88	120	122	114
2	.....	110	251	284	114	87	109	125	115
3	.....	103	233	243	114	87	94	128	117
4	.....	100	226	221	112	87	90	136	114
5	.....	101	200	219	109	85	94	136	112
6	.....	106	200	221	104	85	96	139	109
7	.....	153	303	224	100	85	94	143	108
8	.....	161	370	219	97	84	94	147	109
9	.....	175	430	209	97	84	90	149	117
10	.....	163	415	196	97	83	115	139	125
11	.....	224	388	191	96	83	112	138	130
12	.....	231	355	205	96	83	109	128	134
13	90	233	314	214	94	82	106	130	132
14	93	196	303	191	94	82	104	125	125
15	97	191	298	219	93	81	120	122	122
16	100	180	251	198	92	81	128	120	120
17	97	168	246	196	92	80	126	117	118
18	112	295	298	191	92	78	115	117	117
19	128	303	259	186	90	76	109	115	117
20	130	384	248	189	90	74	112	115	115
21	168	275	241	173	90	72	109	112	115
22	191	231	221	160	90	71	104	109	115
23	193	384	219	162	90	71	120	106	114
24	186	340	286	155	89	84	134	103	114
25	175	397	337	153	89	78	125	134	112
26	153	403	355	149	89	77	120	139	109
27	134	409	295	147	89	76	117	128	.....
28	123	394	259	143	89	76	125	125	.....
29	122	370	248	132	89	76	128	122	.....
30	120	292	298	122	88	76	125	123	.....
31	109	.....	278	.....	88	75	.....	120	.....

NOTE.—These discharges are based on a curve that is well defined between 70 and 350 second-feet. Discharges estimated July 20 to 26.

Monthly discharge of Birch Creek near Dupuyer, Mont., for 1910.

[Drainage area, 155 square miles.]

Month.	Discharge in second-feet.				Run-off.		
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	Accuracy.
January	.....	.....	[a] 90	0.581	0.67	5,530	
February	.....	.....	[a] 90	.581	.60	5,000	
March	193	90	[a] 116	.748	.86	7,130	C.
April	409	100	239	1.54	1.72	14,200	A.
May	430	200	287	1.85	2.13	17,600	A.
June	286	122	193	1.25	1.40	11,500	A.
July	117	88	95.8	.618	.71	5,890	A.
August	88	71	80.2	.517	.60	4,930	A.
September	128	90	111	.716	.80	6,600	A.
October	149	103	126	.813	.94	7,750	A.
November	134	.....	[a] 114	.735	.82	6,780	A.
December	.....	.....	[a] 85	.548	.63	5,230	
The year	430	71	136	.875	11.88	98,100	

[a] Discharge estimated Jan. 1 to Mar. 12 and Nov. 27 to Dec. 31 because of ice.

NOTE.—The means for January, February, and December are only approximate.

DUPUYER CREEK AT DUPUYER, MONT.

Dupuyer Creek is tributary to Birch Creek.

This station, which was established April 15, 1908, is located at the highway bridge in the town of Dupuyer, Mont.

The original staff gage was nailed to the cribbing under the east end of the highway bridge. The gage was washed out July 28, 1909, and was replaced September 20, 1909, gage readings being reduced to the original datum.

In the spring of 1909 a breakwater was constructed on the left (west) bank which deflected the water to the opposite side. A new gage was installed April 25, 1910, at the same location and to the original datum, but owing to the changes in the channel the 1910 gage record is not directly comparable with that for earlier years.

High-water discharge measurements are made from the downstream side of the highway bridge. Low-water measurements are made by wading. Frequent measurements are necessary to insure good results at this station as conditions at the channel are unfavorable. Ice affects the results during the winter months.

Discharge measurements of Dupuyer Creek at Dupuyer, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 25	M. E. McChristie	16	15	1.04	26
May 19	W. A. Lamb	18	19	1.15	40
June 17	M. E. McChristie	16	12	.79	12
Aug. 5	....do	11	3.6	.50	1.8
Sept. 16	C. S. Heidel	20	13	.85	14
Nov. 30[a]	....do	18	11	1.67	23

[a] Ice.

Daily gage height, in feet, of Dupuyer Creek at Dupuyer, Mont., for 1910.

[John Pfeiffer, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.0	1.0	0.75	0.5	0.5	1.1	1.1	1.6
2	.....	1.0	1.0	.75	.5	.5	1.1	1.1	1.6
3	.....	1.0	1.0	.75	.5	.5	1.1	1.1	1.6
4	.....	1.0	1.0	.5	.5	.75	1.1	1.1	1.5
5	.....	1.0	1.0	.5	.5	.75	1.1	1.1	1.5
6	.....	1.0	1.0	.5	.5	.75	1.1	1.1	1.5
7	.....	1.0	1.0	.5	.5	.75	1.1	1.1	1.4
8	.....	1.0	1.0	.5	.5	.75	1.1	1.1	1.4
9	.....	1.0	1.1	.5	.5	.75	1.1	1.1	1.4
10	.....	1.0	1.1	.5	.5	.75	1.1	1.1	1.4
11	.....	1.0	1.0	.5	.5	.75	1.1	1.1	1.5
12	.....	1.1	1.0	.5	.5	.75	1.1	1.1	1.5
13	.....	1.1	1.1	.5	.5	.75	1.1	1.1	1.5
14	.....	1.1	1.1	.5	.5	.75	1.1	1.1	1.5
15	.....	1.1	1.0	.5	.5	.75	1.1	1.1	1.5
16	.....	1.1	.9	.5	.5	.85	1.1	1.1	1.5
17	.....	1.1	.8	.5	.5	1.1	1.1	1.1	1.5
18	.....	1.15	.75	.5	.5	1.1	1.1	1.1	1.5
19	.....	1.15	.75	.5	.5	1.1	1.1	1.1	1.5
20	.....	1.15	.75	.5	.5	1.1	1.1	1.25	1.5
21	.....	1.1	.75	.5	.5	1.1	1.1	1.25	1.5
22	.....	1.1	.75	.5	.5	1.1	1.1	1.25	1.5
23	.....	1.1	.75	.5	.5	1.25	1.1	1.25	1.5
24	.....	1.1	.75	.5	.5	1.25	1.1	1.5	1.5
25	1.1	1.1	.75	.5	.5	1.25	1.1	1.5	1.5
26	1.1	1.1	.75	.5	.5	1.1	1.1	1.5	1.5
27	1.1	1.1	.75	.5	.5	1.1	1.1	1.5	1.5
28	1.0	1.1	.75	.5	.5	1.1	1.1	1.5	1.5
29	1.0	1.1	.75	.5	.5	1.1	1.1	1.5	1.5
30	1.0	1.0	.75	.5	.5	1.1	1.1	1.5	1.5
31	.....	1.0	.....	.5	.5	.....	1.1	.....	1.5

NOTE.—Discharge affected by ice after Nov. 19.

Daily discharge, in second-feet, of Dupuyer Creek at Dupuyer, Mont., for 1910.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	24	24	9.8	1.8	1.8	33	33
2	.....	24	24	9.8	1.8	1.8	33	33
3	.....	24	24	9.8	1.8	1.8	33	33
4	.....	24	24	1.8	1.8	9.8	33	33
5	.....	24	24	1.8	1.8	9.8	33	33
6	.....	24	24	1.8	1.8	9.8	33	33
7	.....	24	24	1.8	1.8	9.8	33	33
8	.....	24	24	1.8	1.8	9.8	33	33
9	.....	24	33	1.8	1.8	9.8	33	33
10	.....	24	33	1.8	1.8	9.8	33	33
11	.....	24	24	1.8	1.8	9.8	33	33
12	.....	33	24	1.8	1.8	9.8	33	33
13	.....	33	33	1.8	1.8	9.8	33	33
14	.....	33	33	1.8	1.8	9.8	33	33
15	.....	33	24	1.8	1.8	9.8	33	33
16	.....	33	17	1.8	1.8	14	33	33
17	.....	33	12	1.8	1.8	33	33	33
18	.....	38	9.8	1.8	1.8	33	33	33
19	.....	38	9.8	1.8	1.8	33	33	33
20	.....	38	9.8	1.8	1.8	33	33	.....
21	.....	33	9.8	1.8	1.8	33	33	.....
22	.....	33	9.8	1.8	1.8	33	33	.....
23	.....	33	9.8	1.8	1.8	50	33	.....
24	.....	33	9.8	1.8	1.8	50	33	.....
25	33	33	9.8	1.8	1.8	50	33	.....
26	33	33	9.8	1.8	1.8	33	33	.....
27	33	33	9.8	1.8	1.8	33	33	.....
28	24	33	9.8	1.8	1.8	33	33	.....
29	24	33	9.8	1.8	1.8	33	33	.....
30	24	24	9.8	1.8	1.8	33	33	.....
31	.....	24	.....	1.8	1.8	.....	33	.....

NOTE.—These discharges are based on a rating curve fairly well defined below 45 second-feet.

Monthly discharge of Dupuyer Creek at Dupuyer, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	a 18	1,110	
February	.....	.....	a 20	1,110	
March	.....	.....	a 25	1,540	
April	.....	.....	a 28.4	1,690	
May	38	24	29.7	1,830	A.
June	33	9.8	18.4	1,100	A.
July	9.8	1.8	2.57	158	C.
August	1.8	1.8	1.8	111	C.
September	50	1.8	21.7	1,290	B.
October	33	33	33.0	2,030	B.
November	33	23	a 31.5	1,870	C.
December	.....	.....	a 20	1,230	
The year	.....	.....	20.8	15,100	

a Discharge estimated Jan. 1 to Apr. 24 and Nov. 20 to Dec. 31.

NOTE.—The means for January, February, March, April, and December are only approximate.

TETON RIVER NEAR STRABANE,[1] MONT.

Teton River, the most important tributary of Marias River, rises in the Rocky Mountains and flows eastward in a course approximately parallel to that of Sun River, crossing and recrossing the sixth standard parallel north, and emptying into the Marias River about a mile above the point where the latter joins the Missouri.

This station, which is located 1 mile north of Peeble's ranch, 16 miles above Chouteau, Mont., was established November 26, 1904, to obtain data for use in connection with irrigation projects. In 1910 the post office was moved from Belleview to Strabane, Mont.

No important tributaries enter the stream near the station. Deep Creek and Muddy Creek join the Teton below the station. Practically no water is diverted above the station, but the ordinary flow below is appropriated and used for irrigation.

An irrigation project now being constructed under the Carey Act proposes to store the flood water of Teton River in a reservoir located about 5 miles north of the gaging station. The water will be diverted one-half mile above the gage. The capacity of the reservoir is 90,000 acre-feet and can be increased to 210,000 by raising the top of the dam 20 feet. It will serve 120,000 acres of land on the north side of the river.

The first gage was spiked to a post on the left bank about 40 feet above the bend of Kroff's irrigation ditch. March 9, 1905, it was moved by the observer 250 feet upstream to avoid the effect of the dam erected at the head of the ditch below. On May 8, 1905, the gage was referred to the bench marks, and it was found that the datum had been raised 0.78 foot in moving, while the difference between the level of the water surface at the old and new locations

[1] This station was known as "Teton River near Belleview, Mont.," in earlier years.

was but 0.10 foot. The gage datum was lowered on this date 0.20 foot. May 8, 1906, the gage was again moved 1½ miles upstream to Mr. Bjornstad's new ranch and set at an entirely different datum. The station was discontinued during 1907, but was reestablished again June 16, 1908, near the location of the gage that was used during 1906, but there is no connection between the gage readings.

A standard chain gage on the left bank is used at this new location. Measurements in flood are made from the cable about one-fourth mile above the gage. The current is swift at the gage and the river never freezes across. The conditions for obtaining accurate discharge data during high water are rather poor on account of the shifting channel.

Discharge measurements of Teton River near Strabane, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 18	W. A. Lamb	34	75	5.08	131
May 25	R. Richards	28	63	5.57	408
June 21[a]	W. A. Lamb	61	79	4.80	205
Aug. 9[b]	C. S. Heidel	38	30	4.04	57
Sept. 14[c]	do	20	32	4.02	62
Nov. 2[d]	do	35	30	3.97	54

[a] Made by wading below cable.
[b] Made by wading at ford.
[c] Made by wading at cable.
[d] Made by wading below cable; discharge affected by ice.

Daily gage height, in feet, of Teton River near Strabane, Mont., for 1910.

[B. H. Peebles, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.5	4.5	4.4	4.7	6.1	5.4	4.3	4.15	4.1	3.95	3.95	4.05
2	4.5	4.5	4.5	4.7	6.3	5.45	4.4	4.2	4.2	4.05	4.0	4.05
3	4.7	4.6	4.65	4.8	6.15	5.3	4.3	4.1	4.0	4.1	4.1	4.1
4	4.6	4.5	4.6	4.7	6.25	5.4	4.5	4.1	4.1	4.15	4.05	3.95
5	4.6	4.55	4.7	4.7	6.15	5.2	4.35	4.0	4.2	4.2	4.1	4.0
6	4.8	4.7	4.8	4.8	5.75	5.2	4.35	3.95	4.2	4.25	4.15	3.95
7	4.7	4.6	4.6	4.8	5.7	5.1	4.2	3.75	4.2	4.3	4.2	3.9
8	4.7	4.6	4.6	4.8	5.75	5.3	4.3	3.95	4.3	4.35	4.25	3.9
9	4.7	4.5	4.6	4.8	5.8	5.25	4.15	3.9	4.3	4.25	4.25	3.9
10	4.8	4.6	4.65	4.9	5.9	5.45	4.4	4.15	4.45	4.4	4.3	4.0
11	4.7	4.45	4.5	4.7	5.7	5.45	4.3	4.0	4.15	4.35	4.25	3.95
12	4.8	4.4	4.5	4.75	5.75	5.4	4.4	4.2	4.2	4.25	4.25	3.95
13	4.9	4.5	4.6	4.95	5.55	5.2	4.2	4.0	3.95	4.2	4.4	4.0
14	4.8	4.4	4.5	4.9	5.5	5.2	4.3	4.05	4.0	4.15	4.35	4.05
15	4.75	4.35	4.5	5.05	5.5	5.0	4.1	4.0	4.0	4.1	4.4	4.1
16	4.8	4.4	4.65	5.2	5.4	5.0	4.2	4.0	3.9	4.05	4.3	4.05
17	4.7	4.4	4.6	5.1	5.5	4.9	4.0	4.0	3.75	4.05	4.35	4.05
18	4.7	4.35	4.6	5.1	5.4	4.95	4.2	4.1	3.85	4.1	4.3	4.1
19	4.7	4.3	4.7	5.25	5.5	4.8	4.15	3.9	3.8	4.05	4.25	4.05
20	4.8	4.4	4.8	5.45	5.65	4.85	4.4	4.05	4.05	4.15	4.25	4.0
21	4.65	4.25	4.7	5.35	5.5	4.65	4.2	3.8	3.9	4.15	4.15	3.95
22	4.6	4.2	4.7	5.35	5.55	4.7	4.2	3.85	4.1	4.15	4.15	3.95
23	4.7	4.4	4.8	5.5	5.4	4.55	4.1	3.7	4.1	4.3	4.15	4.0
24	4.6	4.3	4.8	5.45	5.4	4.6	4.1	3.8	4.25	4.25	4.05	4.0
25	4.6	4.35	4.8	5.65	5.6	4.4	4.0	3.75	4.3	4.3	4.1	4.1
26	4.65	4.5	4.9	5.85	5.5	4.4	4.1	3.9	4.2	4.2	4.05	4.05
27	4.5	4.4	4.8	6.0	5.45	4.35	4.0	3.8	4.1	4.15	4.05	4.05
28	4.5	4.4	4.8	6.1	5.4	4.5	4.15	4.0	4.1	4.25	4.0	4.05
29	4.45	.....	4.8	6.1	5.35	4.4	4.1	3.9	4.0	4.15	4.0	3.95
30	4.5	.....	4.9	6.1	5.4	4.5	4.3	4.1	4.1	4.1	4.1	3.9
31	4.4	.....	4.8	.....	5.3	.....	4.2	4.1	.....	4.05	.....	3.85

Daily discharge, in second-feet, of Teton River near Strabane, Mont., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	85	72	52	65	446	360	99	74	67	50	50	61
2	85	72	57	65	490	374	117	82	82	61	55	61
3	118	86	62	72	500	333	99	67	55	67	67	67
4	100	70	66	65	508	360	137	67	67	74	61	50
5	100	77	71	64	440	306	108	55	82	82	67	55
6	136	100	102	63	375	306	108	50	82	90	74	50
7	117	83	62	70	363	280	82	36	82	99	82	46
8	117	83	63	77	370	333	99	50	99	108	90	46
9	117	69	64	85	390	320	74	46	99	90	90	46
10	133	83	67	102	392	374	117	74	127	117	99	55
11	117	62	57	103	395	374	99	55	74	108	90	50
12	132	57	58	104	405	360	117	82	82	90	90	50
13	150	68	66	107	350	306	82	55	50	82	117	55
14	130	57	62	98	325	306	99	61	55	74	108	61
15	120	52	63	125	318	254	67	55	55	67	117	67
16	129	56	63	170	317	254	82	55	46	61	99	61
17	110	56	67	131	320	229	55	55	36	61	108	61
18	110	51	68	131	327	242	82	67	42	67	99	67
19	110	48	78	170	355	205	74	46	38	61	90	61
20	126	55	93	220	408	217	117	61	61	74	90	55
21	98	44	70	200	370	170	82	38	46	74	74	50
22	88	42	71	207	388	181	82	42	67	74	74	50
23	105	55	71	248	352	148	67	33	67	99	74	55
24	88	47	72	238	355	158	67	38	90	90	61	55
25	88	51	72	280	416	117	55	36	99	99	67	67
26	96	64	103	352	388	117	67	46	82	82	61	61
27	73	53	74	397	374	108	55	38	67	74	61	61
28	73	53	75	405	360	137	74	55	67	90	55	61
29	67	.....	75	425	346	117	67	46	55	74	55	50
30	73	.....	105	450	360	137	99	67	67	67	67	46
31	60	.....	89	.....	333	.....	82	67	.....	61	.....	42

NOTE.—These discharges are based on rating curves applicable as follows: Jan. 1 to May 24, indirect method for shifting channels used; May 25 to Dec. 31, fairly well defined between 50 and 450 second-feet.

Monthly discharge of Teton River near Strabane, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	150	60	105	6,460	C.
February	100	42	63.	3,500	C.
March	105	52	71.	4,400	C.
April	450	63	176	10,500	C.
May	508	317	382	23,500	C.
June	374	108	249	14,800	A.
July	137	55	87.5	5,380	B.
August	82	33	54.8	3,370	B.
September	127	36	69.6	4,140	B.
October	117	50	79.6	4,890	B.
November	117	50	79.7	4,740	B.
December	67	42	55.6	3,420	B.
The year	508	33	123	89,100	

JUDITH RIVER BASIN.

JUDITH RIVER NEAR LEWISTOWN, MONT.

Judith River rises in the southern part of Fergus County, Mont., and flows northward about 70 miles to its junction with Missouri River. Near its source it receives a number of small tributaries which rise in the Little Belt and Snowy mountains.

A portion of the drainage area near the headwaters is included in the Snowy Mountains and Little Belt national forests. The central portion of the drainage area contains large areas of excellent farming land.

Water is diverted from the main stream and its tributaries for irrigation. The lower portion of the drainage area is hilly and broken.

A gaging station was established September 9, 1910, near Lewistown, Mont., just below the mouth of Warm Spring Creek, a stream entering Judith River from the east about 30 miles from its mouth. The station was established to obtain data for power and irrigation projects in that vicinity.

The gage is an ordinary staff fastened to a post driven in the left bank of the stream. Measurements are made by wading. Gage datum has remained constant. The warm water discharged by Warm Spring Creek causes the section at the gage to remain open throughout the year.

The following discharge measurement was made by Raymond Richards:

September 9, 1910: Width, 87 feet; area, 121 square feet; gage height, 1.28 feet; discharge, 344 second-feet.

Daily gage height, in feet, of Judith River near Lewistown, Mont., for 1911.

[John S. Shields, observer.]

Day.	Sept.	Oct.	Nov.	Dec.
1		1.3	1.3	1.3
2		1.3	1.3	1.3
3		1.3	1.3	1.3
4		1.3	1.3	1.3
5		1.3	1.3	1.3
6		1.3	1.3	1.3
7		1.3	1.3	1.3
8		1.3	1.3	1.3
9	1.3	1.3	1.3	1.3
10	1.3	1.3	1.3	1.3
11	1.5	1.3	1.3	1.3
12	1.3	1.3	1.3	1.3
13	1.3	1.3	1.3	1.3
14	1.3	1.3	1.3	1.3
15	1.3	1.3	1.3	1.3
16	1.3	1.2	1.3	1.3
17	1.3	1.2	1.3	1.3
18	1.3	1.2	1.3	1.3
19	1.3	1.2	1.3	1.3
20	1.3	1.2	1.3	1.3
21	1.3	1.2	1.3	1.3
22	1.3	1.2	1.3	1.3
23	1.3	1.2	1.3	1.3
24	1.3	1.2	1.3	1.3
25	1.3	1.2	1.3	1.3
26	1.3	1.2	1.3	1.3
27	1.3	1.2	1.3	1.3
28	1.3	1.2	1.3	1.3
29	1.3	1.2	1.3	1.3
30	1.3	1.3	1.3	1.3
31		1.3		1.3

MUSSELSHELL RIVER BASIN.

DESCRIPTION.

Musselshell River is formed by two forks. The North Fork (or master stream) rises on the southern slopes of the Little Belt Mountains in the northern part of Meagher County, Mont., at an elevation of 8,000 feet above sea level, flows southeastward for 10 miles, emerging into an irrigable valley, one-half mile to 1 mile in width, and joining the South Fork near the town of Martinsdale, 30 miles below its source, at an elevation of 4,700 feet above sea level. The South Fork has its source in several small streams draining the northward slopes of Crazy Mountains, about 20 miles southwest of Martinsdale, at an elevation of 5,500 feet above sea level, and flows northeastward through a valley 1 mile to 3 miles wide. From Martinsdale the Musselshell flows almost due east for 130 miles to Melstone, where it turns abruptly to the north, and 60 miles farther on it enters the Missouri.

Below the forks the valley widens and is bordered by low rolling hills. The larger part of the basin is covered by glacial deposits. The soil is black loam, and when properly irrigated the land is suitable for agriculture. Forestation is scant. At the headwaters of the North Fork pines are found, but elsewhere the timber consists only of the few cottonwoods and willows that border the stream channels. The mean annual rainfall is about 25 inches in the upper areas of the basin, but near the mouth of the river it decreases to 12 inches.

The principal source of supply for the streams in this basin is the melting snow. Ice forms on the streams during the winter months.

The tributaries of the Musselshell are small intermittent streams, and the river exhibits wide variations in discharge. Much of the water is used for irrigation, the diversions all being small. During the irrigating season the Musselshell carries but little water.

A project now under way under the Carey Act will utilize a small but excellent reservoir site on the North Fork to store the flood waters of that stream and of Checkerboard Creek, which will be diverted into the reservoir. The dam will be 130 feet high and the reservoir will store 28,000 acre-feet of water. The dam site is 19½ miles from Martinsdale.

The Musselshell basin affords no opportunities for power development. The fall of greatest magnitude occurs on the upper North Fork, but the supply of water is insufficient to warrant an expenditure necessary to develop it.

The longest records of stream flow in the Musselshell basin have been kept at Shawmut and Harlowton. The wettest year recorded was 1908, while the driest was 1906.

NORTH FORK OF MUSSELSHELL RIVER NEAR DELPINE, MONT.

This station, which is located about 16 miles northeast of Martinsdale and 3 miles above Delpine at a proposed dam site, was established May 19, 1909, to determine the amount of water available for storage. The drainage area above the gaging station affords an excellent reservoir site, and with a 130-foot dam at the station 28,000 acre-feet of water may be stored. No important tributaries enter above the station. Several ditches take water for irrigation.

An ordinary staff gage is nailed securely to a foot log which spans the stream near the left bank. Measurements are made from this log or by wading.

The station is at a high altitude, and the stream freezes entirely over during cold weather. The gage datum has remained unchanged and records obtained are good. The gage at this station during 1909 has not been in the best condition and the records obtained are not as reliable as could be wished.

Discharge measurements of North Fork of Musselshell River near Delpine, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 7	Raymond Richards	11	8.7	1.80	18
July 14[a]	C. S. Heidel	10	5	1.40	5
Aug. 25[a]	do	7	3.3	1.42	6.4
Oct. 14[a]	do	8	3.3	1.40	5.0

[a] Made by wading.

Daily gage height, in feet, of North Fork of Musselshell River near Delpine, Mont., for 1910.

[Thos. Harbor, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.80	1.85	1.60	1.45	1.45	1.40	.....	.....	1.70
2	.....	1.80	1.80	1.60	1.42	1.45	1.40	.....	.....	1.75
3	.....	1.81	1.80	1.60	1.42	1.45	1.40	.....	.....	1.70
4	.....	1.82	1.80	1.58	.....	1.43	1.40	.....	.....	.....
5	.....	1.90	1.80	1.60	1.43	1.43	1.40	.....	.....	.....
6	.....	1.87	1.75	1.60	1.45	1.40	1.40	.....	.....	.....
7	.....	1.85	1.75	1.65	1.45	1.40	1.40	.....	.....	.....
8	.....	1.90	1.75	2.00	1.45	1.45	1.40	.....	.....	.....
9	.....	1.90	1.80	1.80	1.45	1.43	1.40	.....	.....	.....
10	2.10	1.90	2.05	1.65	1.43	1.43	1.42	.....	1.50	.....
11	2.23	1.88	1.85	1.65	1.42	1.42	1.42	.....	1.50	.....
12	3.30	1.90	1.85	1.58	1.42	1.42	1.42	.....	1.50	.....
13	3.50	1.90	1.85	1.58	1.40	1.42	1.43	.....	.....	.....
14	3.05	1.85	1.85	1.58	1.40	1.42	1.45	1.40	.....	.....
15	3.10	1.80	1.85	1.58	1.40	1.42	1.45	.....	1.50	.....
16	2.70	1.90	1.90	1.58	1.40	1.42	1.43	.....	1.50	.....
17	2.45	1.90	1.85	1.57	1.40	1.42	1.43	.....	1.50	.....
18	2.90	1.70	1.85	1.55	1.40	1.42	1.43	.....	1.50	.....
19	2.25	1.73	1.83	1.53	.....	1.42	1.45	.....	1.50	.....
20	2.15	1.75	1.83	1.50	.....	1.42	1.45	.....	1.50	.....

Daily gage height, in feet, of North Fork of Musselshell River near Delpine, Mont., for 1910—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	2.30	1.80	1.80	1.50	.....	1.42	1.45	.....	1.50	.....
22	2.45	1.80	1.80	1.55	.....	1.42	1.43	.....	1.55	.....
23	2.05	1.80	1.75	1.50	.....	1.42	1.45	.....	1.60	.....
24	2.00	1.80	1.70	1.45	.....	1.42	1.45	.....	1.60	.....
25	1.95	1.80	1.75	1.45	1.38	1.42	1.45	.....	1.70	.....
26	1.95	1.80	1.90	1.45	1.38	1.42	1.45	.....	1.70	.....
27	1.90	1.75	1.88	1.42	1.38	1.42	1.45	.....	1.70	.....
28	1.85	1.80	1.80	1.42	1.38	1.42	1.45	.....	1.70	.....
29	1.80	1.83	1.75	1.42	1.40	1.40	1.45	.....	1.70	.....
30	1.80	1.85	1.75	1.45	1.45	1.40	.....	.....	1.70	.....
31	1.75	.....	1.70	.....	1.45	1.40	.....	.....	.....	.....

NOTE.—Ice probable Jan. 1 to about Mar. 9 and Nov. 22 to Dec. 31.

Daily discharge, in second-feet, of North Fork of Musselshell River near Delpine, Mont., for 1910.

Day.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	18	20	10	6.6	6.6	5.2	.....	.....	.....
2	.....	18	18	10	5.7	6.6	5.2	.....	.....	.....
3	.....	18	18	10	5.7	6.6	5.2	.....	.....	.....
4	.....	19	18	10	5.9	6.1	5.2	.....	.....	.....
5	.....	23	18	10	6.1	6.1	5.2	.....	.....	.....
6	.....	21	16	10	6.6	5.2	5.2	.....	.....	.....
7	.....	20	16	12	6.6	5.2	5.2	.....	.....	.....
8	.....	23	16	28	6.6	6.6	5.2	.....	.....	.....
9	.....	23	18	18	6.6	6.1	5.2	.....	.....	.....
10	35	23	31	12	6.1	6.1	5.7	.....	7.5	.....
11	44	22	20	12	5.7	5.7	5.7	.....	7.5	.....
12	156	23	20	10	5.7	5.7	5.7	.....	7.5	.....
13	178	23	20	10	5.2	5.7	6.1	.....	.....	.....
14	128	20	20	10	5.2	5.7	6.6	5.2	.....	.....
15	134	18	20	10	5.2	5.7	6.6	.....	7.5	.....
16	90	23	23	10	5.2	5.7	6.1	.....	7.5	.....
17	65	23	20	9.5	5.2	5.7	6.1	.....	7.5	.....
18	112	14	20	8.9	5.2	5.7	6.1	.....	7.5	.....
19	46	15	19	8.3	5.1	5.7	6.6	.....	7.5	.....
20	38	16	19	7.5	5.1	5.7	6.6	.....	7.5	.....
21	50	18	18	7.5	5.0	5.7	6.6	.....	7.5	.....
22	65	18	18	8.9	4.9	5.7	6.1	.....	.....	.....
23	32	18	16	7.5	4.8	5.7	6.6	.....	.....	.....
24	28	18	14	6.6	4.8	5.7	6.6	.....	.....	.....
25	25	18	16	6.6	4.8	5.7	6.6	.....	.....	.....
26	25	18	23	6.6	4.8	5.7	6.6	.....	.....	.....
27	23	16	22	5.7	4.8	5.7	6.6	.....	.....	.....
28	20	18	18	5.7	4.8	5.7	6.6	.....	.....	.....
29	18	19	16	5.7	5.2	5.2	6.6	.....	.....	.....
30	18	20	16.	6.6	6.6	5.2	6.6	.....	.....	.....
31	16	.....	14	.....	6.6	5.2	.....	.....	.....	7.5

NOTE.—These discharges are based on a poorly defined rating curve. Discharges interpolated for days on which gage was not read.

Monthly discharge of North Fork of Musselshell River near Delpine, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January			[a] 10	615	
February			[a] 10	555	
March	178		[a] 49	3,010	
April	23	14	19.5	1,160	C.
May	31	14	18.7	1,150	C.
June	28	5.7	9.79	583	C.
July	6.6	4.8	5.56	342	C.
August	6.6	5.2	5.79	356	C.
September	6.6	5.2	6.01	358	C.
October			[b] 6.05	372	D.
November			[b] 7.5	446	D.
December			[a] 7.5	461	
The period			13.0	9,410	

[a] Discharge estimated Jan. 1 to Mar. 9 and Nov. 22 to Dec. 31 because of ice.
[b] Discharges Oct. 1 to 13, 15 to 31, Nov. 1 to 9 interpolated.

NOTE.—The means for January, February, and December are only approximate.

NORTH FORK OF MUSSELSHELL RIVER NEAR MARTINSDALE, MONT.

This station, which was established May 10, 1907, to determine the amount of water available for irrigation, is located at the ranch of Martin J. Settle, 4 miles north of Martinsdale and half a mile above the junction of the North and South forks.

All the tributaries to the North Fork enter the stream above the station, the principal ones being Checkerboard and Flagstaff creeks.

Under a Carey Act project the water of this fork, which is practically all appropriated, will be stored about 20 miles above the station and used to irrigate land between Martinsdale and Harlowton.

A chain gage on the left bank of the stream just above the observer's private wagon bridge is used. Its datum has remained the same. Measurements may be made from this bridge or by wading.

The bed of the stream is composed of gravel and may shift somewhat during high water, as the current is swift. Ice forms during the winter season, but records obtained during the open season are very good.

Discharge measurements of North Fork of Musselshell River near Martinsdale, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 6	Raymond Richards	31	28	3.80	96
May 19	do	28	25	3.50	46
July 14	C. S. Heidel	10	3.9	2.92	2.9
Aug. 25	do	6	1.6	2.94	1.7
Oct. 13	do	10	6	3.24	16

NOTE.—Measurements during 1910 made by wading about 200 feet downstream from the gage.

Daily gage height, in feet, of North Fork of Musselshell River near Martinsdale, Mont., for 1910.

[Martin J. Settle, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.71	3.8	3.15	2.85	2.8	2.95	3.2	3.6	3.6
2	.....	3.76	3.75	3.15	2.9	2.8	3.1	3.3	3.6	3.6
3	.....	3.76	3.7	3.05	2.9	2.9	2.95	3.2	3.6	3.5
4	.....	3.56	3.7	3.05	2.9	2.75	2.9	3.25	3.4	3.4
5	.....	3.66	3.75	3.05	3.2	2.75	3.0	3.35	3.5	3.4
6	.....	3.8	3.7	3.05	3.0	2.85	2.95	3.25	3.5	3.5
7	5.66	3.8	3.65	3.05	2.95	2.8	3.2	3.3	3.65	3.3
8	5.46	3.8	3.6	3.4	2.9	2.8	3.2	3.2	3.4	3.4
9	5.26	3.85	3.6	3.3	2.9	2.8	3.15	3.2	3.4	3.4
10	5.06	3.9	3.75	3.3	3.0	2.9	3.2	3.3	3.4	3.3
11	4.96	3.9	3.8	3.15	2.9	2.8	3.2	3.2	3.4	.....
12	5.06	4.0	3.7	3.15	3.0	2.8	3.25	3.3	3.4	.....
13	5.06	4.0	3.7	3.1	2.9	2.95	3.15	3.25	3.4	.....
14	4.66	3.95	3.65	3.1	2.9	2.85	3.15	3.25	3.4	.....
15	4.26	3.85	3.65	3.0	3.0	2.85	3.25	3.25	3.4	.....
16	3.96	3.85	3.65	3.0	2.9	2.95	3.1	3.25	3.55	.....
17	3.96	3.85	3.65	3.0	2.85	2.8	3.2	3.25	3.6	.....
18	4.06	3.85	3.55	3.0	2.85	2.85	3.2	3.25	3.4	.....
19	4.06	3.8	3.5	3.0	2.9	2.85	3.15	3.25	3.4	.....
20	4.06	3.8	3.5	3.1	3.0	2.95	3.25	3.25	3.5	.....
21	4.26	3.8	3.5	2.9	2.9	2.8	3.2	3.25	3.4	.....
22	4.16	3.8	3.5	2.95	2.9	2.8	3.35	3.25	3.4	.....
23	4.16	3.75	3.45	2.95	2.85	2.9	3.25	3.25	3.4	.....
24	3.96	3.75	3.4	2.95	2.85	2.85	3.2	3.2	3.5	.....
25	3.86	3.75	3.5	2.95	2.95	2.9	3.4	3.2	3.5	.....
26	3.86	3.75	3.5	2.95	2.85	3.05	3.3	3.3	3.4	.....
27	3.76	3.7	3.4	2.9	2.8	2.85	3.35	3.3	3.4	.....
28	3.76	3.15	3.35	2.85	2.8	2.85	3.25	3.25	3.6	.....
29	3.66	3.9	3.3	2.85	2.8	2.9	3.2	3.3	3.6	.....
30	3.66	3.8	3.55	2.95	2.9	3.05	3.3	3.25	3.5	.....
31	3.71	.....	3.2	.....	2.8	2.9	.....	3.6	.....	.....

NOTE.—Gage heights probably affected by ice, Jan. 1 to about Mar. 6 and Nov. 17 to Dec. 31.

Daily discharge, in second-feet, of North Fork of Musselshell River near Martinsdale, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	77	90	16	1.8	1.0	2	13	52
2	.....	84	83	16	2.5	1.0	7	21	52
3	.....	84	76	9.5	2.5	2.5	2	13	52
4	.....	58	76	9.5	2.5	.5	1	17	30
5	.....	71	83	9.5	20	.5	3	26	41
6	.....	90	76	9.5	6.5	1.8	2	17	41
7	410	90	70	9.5	4.5	1.0	13	21	58
8	376	90	63	40	2.5	1.0	13	13	30
9	335	97	63	30	2.5	1.0	10	13	30
10	297	104	83	30	6.5	2.5	13	21	30
11	280	104	90	16	2.5	1.0	13	13	30
12	297	119	76	16	6.5	1.0	17	21	30
13	297	119	76	12	2.5	4.5	10	17	30
14	228	112	70	12	2.5	1.8	10	17	30
15	160	97	70	6.5	6.5	1.8	17	17	30
16	113	97	70	6.5	2.5	4.5	7	17	.....
17	113	97	70	6.5	1.8	1.0	13	17	.....
18	128	97	57	6.5	1.8	1.8	13	17	.....
19	128	90	51	6.5	2.5	1.8	10	17	.....
20	128	90	51	12	6.5	4.5	17	17	.....
21	160	90	51	2.5	2.5	1.0	13	17	.....
22	144	90	51	4.5	2.5	1.0	26	17	.....
23	144	83	46	4.5	1.8	2.5	17	17	.....
24	113	83	40	4.5	1.8	1.8	13	13	.....
25	98	83	51	4.5	4.5	1.0	30	13	.....
26	98	83	51	4.5	1.8	5.0	21	21	.....
27	84	76	40	2.5	1.0	.5	26	21	.....
28	84	83	35	1.8	1.0	.5	17	17	.....
29	71	104	30	1.8	1.0	1.0	13	21	.....
30	71	90	57	4.5	2.5	5.0	21	17	.....
31	77	.....	20	.....	1.0	1.0	.....	52	.....

NOTE.—These discharges are based on rating curves applicable as follows: Jan. 1 to Aug. 24 fairly well defined; Aug. 25 to Dec. 31 not well defined.

Monthly discharge of North Fork of Musselshell River near Martinsdale, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January			*a* 25	1,540	
February			*a* 20	1,110	
March	410	20	*a* 174	10,700	B.
April	119	58	91	5,420	B.
May	90	20	61.8	3,800	B.
June	40	1.8	10.5	625	C.
July	20	1.0	3.51	216	C.
August	5	0.5	1.83	113	C.
September	30	1.0	13.0	774	C.
October	52	13	18.4	1,130	B.
November	58	30	*a* 33.9	2,020	C.
December	25	20	*a* 22.3	1,370	
The year			39.6	28,800	

a Discharge estimated Jan. 1 to Mar. 6 and Nov. 16 to Dec. 31, because of ice.

NOTE.—The means for January, February, and December are only approximate.

MUSSELSHELL RIVER AT HARLOWTON, MONT.

This station, which was established July 11, 1907, to take the place of the station formerly maintained at Shawmut, is located at the highway bridge 1 mile south of Harlowton. The records furnish information of value for irrigation development.

The tributaries above and below the station are all small streams. American Fork enters the stream between this station and Shawmut.

A large part of the valley is irrigated and many small ditches receive their water supply from the Musselshell. Practically the entire flow of the stream is appropriated. A minimum discharge of 2 second-feet is recorded during the irrigating season at this station.

During the high water of June, 1908, the approaches to the bridge were partly destroyed, but the gage was not disturbed. In October, 1908, the bridge caved in, destroying the gage.

On April 10, 1909, a temporary staff gage was installed which read 0.73 foot too high. On May 24, 1909, a standard chain gage was placed on the upstream side of the new public highway bridge with a datum 0.52 foot greater than the bench mark. The datum of the bench mark was raised 0.52 foot. All gage heights for 1909 were corrected to this new datum.

Measurements may be made from this bridge or by wading. The bed of the stream is composed of sand and gravel and will probably shift in flood.

Discharge measurements of Musselshell River at Harlowton, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 6	Raymond Richards	57	67	1.31	211
May 20	do	62	83	1.53	262
July 15*a*	C. S. Heidel	25	17	.00	16
Aug. 26*a*	do	6	1.1	.33	.8
Oct. 12*a*	do	32	35	.78	67

a Measurements made by wading 100 feet below bridge.

Daily gage height, in feet, of Musselshell River at Harlowton, Mont., for 1910.

[W. G. Yamamota, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.25	1.85	1.25	0.6	0.4	0.3	0.8	0.8	0.9
2	.....	1.2	1.7	1.2	.6	.35	.3	.8	.8	.9
3	.....	1.25	1.7	1.1	.6	.3	.35	.8	.8	.9
4	.....	1.2	1.6	1.1	.6	.2	.35	.8	.8	.8
5	.....	1.3	1.8	1.05	1.1	.2	.35	.8	.8	.8
6	2.0	1.45	1.9	1.0	.9	.1	.4	.8	.8	.7
7	1.8	1.4	1.9	1.0	.75	.1	.4	.8	.8	.7
8	1.75	1.4	1.8	1.85	.6	.15	.45	.8	.8	.7
9	1.55	1.4	1.8	1.5	.6	.2	.5	.8	.8	.7
10	1.5	1.4	1.9	1.3	.6	.2	.5	.8	.8	.7
11	1.6	1.55	2.15	1.1	.6	.2	.5	.8	.85	.7
12	1.7	1.55	2.1	1.05	.6	.3	.55	.8	.85	.7
13	1.65	1.65	2.0	1.0	.6	.3	.6	.8	.85	.75
14	1.65	1.7	1.95	1.0	.6	.3	.7	.75	.85	.75
15	1.85	1.75	1.85	1.0	.5	.3	.7	.75	.8	.75
16	1.8	1.7	1.8	1.0	.5	.3	.7	.75	.8	.75
17	1.75	1.65	1.7	1.0	.5	.3	.7	.75	.85	.75
18	1.65	1.6	1.6	1.0	.5	.3	.7	.75	.85	.75
19	1.8	1.5	1.6	1.0	.5	.3	.7	.75	.9	.7
20	1.75	1.55	1.5	.9	.5	.3	.7	.75	.9	.7
21	1.75	1.55	1.5	.9	.5	.3	.7	.75	.9	.7
22	1.9	1.7	1.4	.8	.5	.3	.8	.75	.9	.65
23	2.0	1.7	1.35	.8	.5	.3	.8	.75	.9	.65
24	1.9	1.7	1.3	.8	.5	.3	.8	.75	.9	.65
25	1.65	1.7	1.35	.8	.45	.3	.8	.7	.95	.....
26	1.6	1.7	1.55	.75	.4	.3	.8	.7	1.0	.....
27	1.5	1.8	1.65	.7	.4	.3	.8	.7	1.1	.....
28	1.5	1.95	1.65	.7	.4	.3	.8	.7	1.1	.....
29	1.4	2.1	1.55	.65	.4	.3	.8	.7	1.0	.....
30	1.35	2.1	1.4	.6	.4	.3	.8	.7	.9	.....
31	1.3	.....	1.3	.....	.4	.3	.....	.8	.....	.....

NOTE.—No observations until March 6. Discharge during January and February was probably affected by ice.

Daily discharge, in second-feet, of Musselshell River at Harlowton, Mont., for 1910.

[W. G. Yamamota, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	100	169	460	169	16	2	0.4	66	66	92
2	100	151	375	151	16	1.2	.4	66	66	92
3	100	169	375	119	16	.4	1.5	66	66	92
4	100	151	322	119	16	0	2.5	66	66	66
5	100	187	430	105	119	0	4.8	66	66	66
6	550	250	490	91	67	0	7	66	66	44
7	430	227	490	91	38	0	9	66	66	44
8	402	227	430	460	16	0	11	66	66	44
9	297	227	430	272	16	0	15	66	66	44
10	272	227	490	187	16	0	15	66	66	44
11	322	297	648	119	16	0	15	66	79	44
12	375	297	615	105	16	.4	21	66	79	44
13	348	348	550	91	16	.4	27	66	79	55
14	348	375	520	91	16	.4	44	55	79	55
15	460	402	460	91	7	.4	44	55	66	55
16	430	375	430	91	7	.4	44	55	66	55
17	402	348	375	91	7	.4	44	55	79	55
18	348	322	322	91	7	.4	44	55	79	55
19	430	272	322	91	7	.4	44	55	92	44
20	402	297	272	67	7	.4	44	55	92	44
21	402	297	272	67	7	.4	44	55	92	44
22	490	375	227	46	7	.4	66	55	92	36
23	550	375	207	46	7	.4	66	55	92	36
24	490	375	187	46	7	.4	66	55	92	36
25	348	375	207	46	4.5	.4	66	44	107	36
26	322	375	297	38	2	.4	66	44	122	36
27	272	430	348	29	2	.4	66	44	156	36
28	272	520	348	29	2	.4	66	44	156	36
29	227	615	297	22	2	.4	66	44	122	36
30	207	615	227	16	2	.4	66	44	92	36
31	187	.....	187	.....	2	.4	.....	66	.....	36

NOTE.—These discharges are based on a rating curve fairly well defined. Discharges Mar. 1 to 5 and Dec. 25 to 31 estimated.

Monthly discharge of Musselshell River at Hartowton, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	a45	2,770	D.
February	.....	.....	a45	2,500	D.
March	550	.....	325	20,000	C.
April	615	151	322	19,200	B.
May	615	187	375	23,100	B.
June	460	16	103	6,130	B.
July	119	2	15.7	965	B.
August	2	0	.37	23	B.
September	66	.4	35.9	2,140	C.
October	66	44	57.8	3,550	B.
November	156	66	85.8	5,110	B.
December	92	.....	49.6	3,050	B.
The year	615	.....	122	88,500	

a Estimated.

CHECKERBOARD CREEK NEAR DELPINE, MONT.

Checkerboard Creek, a small stream with no tributaries, rises in the Little Belt Mountains. The creek is about 12 miles long. It is proposed to carry the water from this creek over a small divide into the reservoir located on the North Fork of Musselshell River.

The gaging station, which is located 2½ miles above the junction of Checkerboard Creek with Musselshell, 21 miles from Martinsdale and 8 miles from Delpine post office, was established May 26, 1909, to determine the amount of water available for irrigation.

The gage is a staff nailed to a foot log and located near the right bank. All measurements are made from this foot log or by wading. As the station is located at a high altitude, ice is common. Since the station was established the gage datum has remained unchanged.

Discharge measurements of Checkerboard Creek near Delpine, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 6	Raymond Richards	14	6.6	0.57	10
July 14	C. S. Heidel	12	4.6	.42	5.6
Aug. 25	do	11	3.4	.42	4.0
Oct. 14	do	12	3.6	.41	3.3

NOTE.—Measurements made by wading.

Daily gage height, in feet, of Checkerboard Creek near Delpine, Mont., for 1910.

[Thos. Harbor, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Nov.	Dec.
1	.....	0.53	0.72	0.52	0.42	0.44	0.42	.....	0.42
2	.....	.53	.70	.52	.42	.44	.42	.....	.42
3	.....	.53	.67	.52	.42	.43	.42	.....	.42
4	.....	.53	.67	.52	.42	.....	.42	.....	.....
5	.....	.53	.62	.52	.42	.43	.42	.....	.42
6	.....	.57	.67	.52	.42	.43	.42	.....	.42
7	.....	.52	.62	.50	.42	.43	.42	.....	.42
8	.....	.62	.62	.57	.42	.43	.42	.....	.42
9	.....	.57	.67	.52	.42	.43	.42	.....	.42
10	.....	.62	.72	.52	.42	.43	.42	.40	.42

Daily gage height, in feet, of Checkerboard Creek near Delpine, Mont., for 1910—Contd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Nov.	Dec.
11	0.56	0.62	0.67	0.52	0.42	0.43	0.42	0.40	0.42
12	.58	.72	.67	.52	.42	.43	.42	.40	.42
13	.63	.72	.67	.52	.42	.43	.42	.....	.42
14	.63	.67	.62	.52	.42	.43	.42	.....	.42
15	.63	.70	.62	.52	.42	.43	.....	.40	.42
16	.63	.67	.64	.52	.42	.43	.42	.40	.42
17	.63	.67	.62	.47	.42	.43	.42	.40	.42
18	.68	.67	.....	.47	.42	.42	.42	.42	.42
19	.63	.67	.57	.45	.....	.42	.42	.....	.....
20	.68	.72	.60	.45	.....	.42	.42	.42	.....
21	.63	.67	.60	.45	.....	.42	.42	.42	.....
22	.53	.72	.57	.45	.....	.42	.42	.42	.....
23	.53	.72	.57	.45	.....	.42	.42	.42	.....
24	.58	.70	.52	.44	.....	.42	.42	.42	.....
25	.55	.70	.57	.44	.44	.42	.40	.42	.....
26	.57	.72	.57	.44	.44	.42	.42	.42	.....
27	.58	.72	.57	.44	.44	.42	.42	.42	.....
28	.53	.72	.57	.43	.44	.42	.37	.42	.....
29	.53	.72	.57	.....	.44	.42	.....	.42	.....
30	.53	.72	.52	.42	.44	.42	.....	.42	.....
31	.53	.....	.52	.....	.44	.42	.....	.....	.....

NOTE.—Gage heights probably affected by ice during January, February, and first part of March. Observer absent Sept. 29 to Nov. 9.

Daily discharge, in second-feet, of Checkerboard Creek near Delpine, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Nov.	Dec.
1	.....	8.4	17	8.2	5.3	5.2	4.1	.....	4.1
2	.....	8.4	16	8.2	5.3	5.2	4.1	.....	4.1
3	.....	8.4	15	8.2	5.3	5.0	4.1	.....	4.1
4	.....	8.4	15	8.2	5.3	5.0	4.1	.....	4.1
5	.....	8.4	12	8.2	5.3	4.9	4.1	.....	4.1
6	.....	9.6	15	8.2	5.3	4.9	4.1	.....	4.1
7	.....	8.2	12	7.6	5.3	4.8	4.1	.....	4.1
8	.....	12	12	9.6	5.3	4.8	4.1	.....	4.1
9	.....	9.6	15	8.2	5.3	4.7	4.1	.....	4.1
10	.....	12	17	8.2	5.3	4.7	4.1	3.3	4.1
11	9.3	12	15	8.2	5.3	4.6	4.1	3.3	4.1
12	9.8	17	15	8.2	5.3	4.6	4.1	3.3	4.1
13	13	17	15	8.2	5.3	4.5	4.1	3.3	4.1
14	13	15	12	8.2	5.6	4.5	4.1	3.3	4.1
15	13	16	12	8.2	5.5	4.4	4.1	3.3	4.1
16	13	15	13	8.2	5.5	4.3	4.1	3.3	4.1
17	13	15	12	6.8	5.4	4.3	4.1	3.3	4.1
18	15	15	10	6.8	5.4	4.2	4.1	4.1	4.1
19	13	15	9.6	6.2	5.4	4.2	4.1	4.1	.....
20	15	17	11	6.2	5.4	4.2	4.1	4.1	.....
21	13	15	11	6.2	5.4	4.1	4.1	4.1	.....
22	8.4	17	9.6	6.2	5.5	4.1	4.1	4.1	.....
23	8.4	17	9.6	6.2	5.5	4.0	4.1	4.1	.....
24	9.8	16	8.2	5.9	5.5	4.0	4.1	4.1	.....
25	9.5	16	9.6	5.9	5.5	4.0	3.3	4.1	.....
26	9.6	17	9.6	5.9	5.5	4.1	4.1	4.1	.....
27	9.8	17	9.6	5.9	5.4	4.1	4.1	4.1	.....
28	8.4	17	9.6	5.6	5.4	4.1	2.7	4.1	.....
29	8.4	17	9.6	5.4	5.3	4.1	2.7	4.1	.....
30	8.4	17	8.2	5.3	5.3	4.1	2.7	4.1	.....
31	8.4	.....	8.2	.....	5.2	4.1	.....	.....	.....

NOTE.—These discharges are based on rating curves applicable as follows: Mar. 11 to July 18, well defined; July 19 to Aug. 25, indirect method for shifting channels used; Aug. 26 to Dec. 31, poorly defined. Discharges interpolated on days on which gage was not read.

Monthly discharge of Checkerboard Creek near Delpine, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January			[a] 4.5	277	
February			[a] 5.0	278	
March			[a] 9.90	609	C.
April	17	8.2	13.8	821	B.
May	17	8.2	12.0	738	B.
June	9.6	5.3	7.22	430	B.
July	5.6	5.2	5.37	330	B.
August	5.2	4.0	4.45	274	B.
September	4.1	2.7	3.93	234	B.
October			[a] 3.3	203	C.
November			[a] 3.65	217	C.
December			[a] 4.06	250	C.
The year			6.43	4,660	

[a] Discharge estimated Jan. 1 to Mar. 10 and Oct. 1 to Nov. 9 and Dec. 19 to 31.

NOTE.—The means for January and February are only approximate. The discharge of the creek during October and Nov. 1 to 9 was constant.

SOUTH FORK OF MUSSELSHELL RIVER NEAR MARTINSDALE, MONT.

This station, which was established June 19, 1907, to determine the amount of water available for irrigation, was originally located near the ranch of Martin J. Settle. On April 28, 1908, it was moved upstream about 1½ miles, near the blacksmith shop of the Martinsdale Sheep Co., and near the public highway, 1¼ miles northeast of Martinsdale.

The South Fork has no important tributaries. Many small ditches take water from the creek, and during the irrigating season all the water is diverted.

When the new station was established a new datum was used, which has remained unchanged. The gage is an ordinary staff nailed to a tree on the right bank of the stream. Measurements may be made by wading near the gage or from a bridge 150 feet below.

The bed of the stream is chiefly gravel and is clean and nonshifting. Ice forms during the winter season, but records obtained during the open season are good.

Discharge measurements of South Fork of Musselshell River near Martinsdale, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 6	Raymond Richards	44	61	2.48	113
May 14	do	47	78	2.88	165
July 14	C. S. Heidel				[a] 0
Aug. 25	do			.70	[b] .2
Oct. 13[c]	do	38	29	1.55	27

[a] Stream dry. [b] Discharge estimated. [c] Made by wading at gage.

Daily gage height, in feet, of South Fork of Musselshell River near Martinsdale, Mont., for 1910.

[J. G. Wallace, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.2	4.0	2.5	0.9	0.7	0.7	1.55	1.5
2	.....	2.3	3.7	2.5	.9	.7	.7	1.55	1.5
3	.....	2.3	3.4	2.5	.9	.7	.7	1.55	1.5
4	.....	2.3	3 3	2.3	1.0	.7	.7	1.5	1.5
5	.....	2.35	3.25	2.2	1.5	.7	.7	1.5	1.5
6	.....	2.3	3.4	2.1	1.35	.7	.7	1.5	1.5
7	.....	2.45	3.4	2.1	1.2	.7	.7	1.5	1.5
8	.....	2.45	3.4	2.2	.8	.7	1.2	1.5	1.55
9	.....	2.6	3.5	2.5	.8	.7	1.25	1.5	1.55
10	.....	2.7	3.6	2.3	.8	.7	1.25	1.5	1.6
11	.....	3.0	4.2	2.3	.8	.7	1 25	1.5	1.6
12	.....	3.1	4.0	2.2	.75	.7	1.3	1.5	1.6
13	3.9	3.25	3.75	2.2	.75	.65	1.3	1.5	1.6
14	3.9	3.25	3.6	2.1	.75	.65	1.3	1.5	1.6
15	3.8	3.5	3.4	2.1	.7	.65	1.3	1.5	1.5
16	3.8	3.0	3.4	2.1	.7	.7	1.3	1.5	1.5
17	3.8	2.9	3.4	2.1	.75	.7	1.3	1.5	1.5
18	3.7	2.85	3.2	2.5	.8	.7	1.3	1.5	1.5
19	3.7	2.85	2.9	2.5	.8	.7	1.5	1.5	1.5
20	3.7	3.1	2.85	2.0	.8	.7	1.55	1.5	1.5
21	3.75	3.3	2.8	2.0	.8	.7	1.6	1.5	1.5
22	3.2	3.25	2.8	1.6	.75	.7	1.6	1.5	1.5
23	3.25	3.25	2.6	1.6	.75	.7	1.65	1.5	1.6
24	2.9	3.25	2.6	1.6	.75	.7	1.65	1.5	1.6
25	2.6	3.3	2.5	1.45	.75	.7	1.5	1.5	1.6
26	2.5	3.4	3.0	1.45	.75	.7	1.5	1.5	1.55
27	2.4	3.6	2.9	1.2	.75	.7	1.6	1.55	1.55
28	2.45	3.8	2.9	1.2	.7	.7	1.6	1.55	1.7
29	2.3	4.5	2.8	1.1	.7	.7	1.6	1.55	1.7
30	2.2	4.3	2.8	.9	.7	.7	1.55	1.55	1.7
31	2.3	.....	2.6	.....	.7	.7	.....	1.55	.....

NOTE.—Probably some ice during January and February, and during December.

Daily discharge, in second-feet, of South Fork of Musselshell River near Martinsdale, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	81	390	116	3	0.5	0.5	27	24
2	.....	92	312	116	3	.5	.5	27	24
3	.....	92	249	116	3	.5	.5	27	24
4	.....	92	231	92	5	.5	.5	24	24
5	.....	98	222	81	24	.5	.5	24	24
6	.....	92	249	71	17	.5	.5	24	24
7	.....	110	249	71	11	.5	.5	24	24
8	.....	110	249	81	2	.5	11	24	27
9	.....	128	268	116	2	.5	13	24	27
10	.....	141	289	92	2	.5	13	24	30
11	.....	183	447	92	2	.5	13	24	30
12	.....	198	390	81	1.2	.5	15	24	30
13	363	222	324	81	1.2	.2	15	24	30
14	363	222	289	71	1.2	.2	15	24	30
15	337	268	249	71	.5	.2	15	24	24
16	337	183	249	71	.5	.5	15	24	24
17	337	168	249	71	1.2	.5	15	24	24
18	312	161	214	116	2	.5	15	24	24
19	312	161	168	116	2	.5	24	24	24
20	312	198	161	62	2	.5	27	24	24
21	324	231	154	62	2	.5	30	24	24
22	214	222	154	30	1.2	.5	30	24	24
23	222	222	128	30	1.2	.5	34	24	30
24	168	222	128	30	1.2	.5	34	24	30
25	128	231	116	22	1.2	.5	24	24	30
26	116	249	183	22	1.2	.5	24	24	27
27	104	289	168	11	1.2	.5	30	27	27
28	110	337	168	11	.5	.5	30	27	37
29	92	545	154	8	.5	.5	30	27	37
30	81	478	154	3	.5	.5	27	27	37
31	92	.....	128	.....	.5	.5	.....	27	.....

NOTE.—These discharges are based on a fairly well defined rating curve. For discharges above 275 second-feet, the 1909 rating was used.

Monthly discharge of South Fork of Musselshell River near Martinsdale, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January			a 20	1,230	
February			a 25	1,390	
March			a 251	15,400	C.
April	545	81	201	12,000	A.
May	447	116	228	14.000	A.
June	116	3	67.1	3,990	A.
July	24	.5	3.13	192	C.
August	.5	.2	.47	29	C.
September	30	.5	16.8	1,000	B.
October	27	24	24.8	1,530	B.
November	37	24	27.3	1,620	B.
December			a 20	1,230	
The year			73.7	53,600	

a Discharge estimated Jan. 1 to Mar. 12 and Dec. 1 to 31.

NOTE.—The means for January, February, and December are only approximate.

AMERICAN FORK NEAR HARLOWTON, MONT.

American Fork rises in the Crazy Mountains and flows northeastward to its junction with the Musselshell, a few miles below the gaging station, which was established July 28, 1907, at the Shaw & Elliott ranch, 5 miles southeast of Harlowton, Mont., to determine the amount of water available for irrigation and storage.

American Fork has no important tributaries except Lebo Creek, which enters the stream a short distance below the station, but receives its water supply from the melting snow on the mountains. The basin of this stream affords some good storage sites, and by holding back the spring flood waters much more land can be put under irrigation.

A chain gage is fastened to the upper bridge rail of a small wagon bridge. Its datum has remained constant. In flood, measurements may be made from this bridge.

Records obtained during the open season are good. The bed of the stream at the gaging station is composed of sand and clay, and shifts only under extreme conditions.

Discharge measurements of American Fork River near Harlowton, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sq. ft.*
Apr. 5	Raymond Richards	7.0	3.0	1.29	3.7
May 20	do	13	6.0	1.52	14.2
July 15	C. S. Heidel				a 0
Aug. 26	do				a 0
Oct. 12	do	6	1.4	1.19	1.7

a Stream dry.

NOTE.—Gage height of zero flow, 1.05 feet.

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Daily gage height, in feet, of American Fork near Harlowton, Mont., for 1910.

[Mrs. Neva Clark, observer.]

Day.	Apr.	May.	June.	July.	Sept.	Oct.	Nov.	Day.	Apr.	May.	June.	July.	Sept.	Oct.	Nov.
1	.....	1.95	1.2	0.55	.....	.....	1.25	16	1.25	1.95	1.2	.....	.....	1.2	1.25
2	.....	1.95	1.2	.55	.....	1.2	1.25	17	1.25	1.85	1.15	.....	.....	1.2	1.2
3	.....	1.85	1.2	.45	.....	1.2	1.25	18	1.25	1.7	1.15	.....	.....	1.2	1.2
4	.....	1.8	1.2	.45	.....	1.2	1.25	19	1.25	1.55	1.1	.....	.....	1.2	1.2
5	.....	1.85	1.15	.45	.....	1.2	1.25	20	1.25	1.5	1.0	.....	.....	1.2	1.2
6	.....	1.9	1.15	.4	.....	1.2	1.25	21	1.2	1.45	1.1	.....	.....	1.2	1.2
7	.....	1.95	1.1	.4	.....	1.2	1.25	22	1.2	1.35	1.0	.....	.....	1.2	1.2
8	.....	2.1	1.45	.35	.....	1.2	1.25	23	1.2	1.25	1.0	.....	.....	1.2	1.2
9	.....	2.1	1.35	.3	.....	1.2	1.25	24	1.2	1.25	1.0	.....	.....	1.2	1.2
10	1.3	2.25	1.25	.15	.....	1.2	1.25	25	1.2	1.2	.85	.....	.....	1.2	1.2
11	1.3	2.45	1.2	.2	.....	1.2	1.25	26	1.2	1.25	.95	.....	1.2	1.2	1.2
12	1.3	2.35	1.2	.2	.....	1.2	1.25	27	1.2	1.25	.8	.....	1.35	1.2	1.2
13	1.3	2.25	1.2	.....	.....	1.2	1.25	28	1.2	1.3	.75	.....	1.25	1.2	.....
14	1.3	2.1	1.2	.....	.....	1.2	1.2	29	1.65	1.35	.6	.....	1.3	1.2	.....
15	1.25	1.95	1.15	.....	.....	1.2	1.2	30	1.9	1.25	.5	.....	1.2	1.25	.....
								31	.....	1.25	.....	.....	.....	1.25	.....

NOTE.—There was probably some ice during January and February and December. Observations did not begin until Apr. 10. Stream dry June 19 to Sept. 25. Water probably standing in pools June 19 to July 12, and change in gage height due to evaporation.

Daily discharge, in second-feet, of American Fork near Harlowton, Mont., for 1910.

Day.	Apr.	May.	June.	Sept.	Oct.	Nov.	Day.	Apr.	May.	June.	Sept.	Oct.	Nov.
1	.....	48	2	.....	2	3	16	3	48	2	.....	2	3
2	.....	48	2	.....	2	3	17	3	38	1	.....	2	2
3	.....	38	2	.....	2	3	18	3	26	1	.....	2	2
4	.....	34	2	.....	2	3	19	3	16	0	.....	2	2
5	.....	38	1	.....	2	3	20	3	12	0	.....	2	2
6	.....	42	1	.....	2	3	21	2	10	0	.....	2	2
7	.....	48	0	.....	2	3	22	2	5.8	0	.....	2	2
8	.....	64	10	.....	2	3	23	2	3	0	.....	2	2
9	.....	64	8	.....	2	3	24	2	3	0	.....	2	2
10	.....	82	3	.....	2	3	25	2	2	0	.....	2	2
11	4	109	2	.....	2	3	26	2	3	0	2	2	2
12	4	95	2	.....	2	3	27	2	3	0	5.8	2	2
13	4	82	2	.....	2	3	28	2	4	0	3	2	.....
14	4	64	2	.....	2	2	29	22	5.8	0	4	2	.....
15	3	48	1	.....	2	2	30	42	3	0	2	3	.....
							31	.....	3	.....	.....	3	.....

Monthly discharge of American Fork near Harlowton, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	a 1.5	92	
February	.....	.....	a 2.6	111	
March	.....	.....	a 6.0	369	
April	.....	.....	5.13	305	C.
May	109	2	35.1	2,160	C.
June	10	0	1.39	83	D.
July	.....	.....	0	0	
August	.....	.....	0	0	
September	5.8	0	.56	33	
October	3	2	2.07	127	C.
November	3	2	2.47	147	C.
December	.....	.....	a 1.5	92	
The year	.....	.....	4.81	3,520	

a Discharge estimated Jan. 1 to Apr. 9 and Nov. 28 to Dec. 31. Stream dry.

NOTE.—Stream dry June 19 to Sept. 25. The means for January, February, March, and December are only approximate.

LEBO CREEK NEAR HARLOWTON, MONT.

Lebo Creek rises at an elevation of 5,600 feet, flows northeastward, and enters American Fork half a mile below the gaging station. It is about 20 miles long, is fed by springs, and its flow is nearly uniform. Its water is used for irrigation.

The gaging station, which was established July 28, 1907, to determine the amount of water available for irrigation, is located near the Shaw & Elliott ranch, 5 miles southeast of Harlowton.

A staff gage is nailed to a pile of the small wagon bridge on the right bank. It has the same datum as American Fork. Measurements are made by wading.

Records obtained are fair. The flow is affected by grass in the stream bed.

Discharge measurements of Lebo Creek near Harlowton, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 5	Raymond Richards	13	6	1.03	13
May 20[a]	do	14	7.9	1.24	19
July 13	C. S. Heidel	8	3.1	.63	2.7
Aug. 26	do	10	5.5	.88	8.8
Oct. 12	do	10	5.8	.98	10.3

[a] Meter not working well.

Daily gage height, in feet, of Lebo Creek near Harlowton, Mont., for 1910.

[Mrs. Neva Clark, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.05	0.90	0.73	0.68	0.93	.....	0.98
2	.....	1.00	.90	.73	.68	.98	0.98	.98
3	.....	1.05	.90	.68	.73	.98	.98	.98
4	1.03	1.10	.85	.68	.73	.98	.98	.98
5	.....	1.35	.90	.73	.63	.93	.98	.98
6	.....	1.35	.90	.78	.63	.98	.98	.98
7	.....	1.30	.85	.78	.63	1.03	.98	.98
8	.....	1.10	1.45	.78	.68	1.23	.98	.98
9	.....	1.10	1.30	.73	.68	1.13	.98	.98
10	1.00	1.20	1.05	.73	.68	1.33	.98	1.03
11	1.05	1.35	.85	.73	.68	1.33	.98	1.03
12	1.10	1.20	.90	.68	.73	1.33	.98	1.03
13	1.05	1.25	1.30	.68	.73	1.43	.98	1.03
14	1.05	1.25	.95	.63	.73	1.33	.98	1.03
15	1.00	1.45	.95	.58	.73	1.33	.98	1.08
16	1.05	1.50	.85	.68	.73	1.43	.98	1.08
17	1.05	1.25	1.08	.53	.73	1.23	.98	1.13
18	.95	1.25	.98	.53	.73	1.23	.98	1.13
19	.90	1.25	.93	.53	.73	1.23	.98	1.13
20	.95	1.25	.88	.48	.73	1.23	.98	1.13
21	.80	1.30	.88	.48	.73	1.28	.98	1.23
22	.80	1.25	.83	.48	.73	1.28	.98	1.23
23	.85	1.25	.78	.43	.73	1.28	.98	1.28
24	.75	1.30	.78	.43	.83	1.28	.98	1.33
25	.80	1.25	.78	.43	.88	1.28	.93	1.43
26	.95	1.25	.73	.48	.88	1.23	.98	1.53
27	.90	1.20	.73	.53	.88	1.23	1.03	1.53
28	.90	1.05	.68	.58	.88	1.13	.98	.....
29	1.05	1.05	.58	.58	.88	1.13	.98	.....
30	1.15	1.05	.58	.58	.93	1.03	.98	.....
31	.....	1.25	.....	.58	.93	.....	.98	.....

NOTE.—There was probably some ice during January and February and after Nov. 20. Observations did not begin until Apr. 10.

Daily discharge, in second-feet, of Lebo Creek near Harlowton, Mont., for 1910.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		13	8.8	4.8	3.7	9.6	a 12	11
2		12	8.8	4.8	3.7	11	11	11
3		13	8.8	3.7	4.8	11	11	11
4	12	15	7.5	3.7	4.8	11	11	11
5		23	8.8	4.8	2.8	9.6	11	11
6		23	8.8	5.9	2.8	11	11	11
7		21	7.5	5.9	2.8	12	11	11
8		15	27	5.9	3.7	19	11	11
9		15	21	4.8	3.7	16	11	11
10	12	18	13	4.8	3.7	22	11	12
11	13	23	7.5	4.8	3.7	22	11	12
12	15	18	8.8	3.7	4.8	22	11	12
13	13	20	21	3.7	4.8	26	11	12
14	13	20	10	2.8	4.8	22	11	12
15	12	27	10	1.9	4.8	22	11	14
16	13	29	7.5	3.7	4.8	26	11	14
17	13	20	14	1.2	4.8	19	11	16
18	10	20	11	1.2	4.8	19	11	26
19	8.8	20	9.6	1.2	4.8	19	11	16
20	10	20	8.3	.7	4.8	19	11	16
21	6.3	21	8.3	.7	4.8	21	11	.....
22	6.3	20	7.0	.7	4.8	21	11	.....
23	7.5	20	5.9	.4	4.8	21	11	.....
24	5.2	21	5.9	.4	7.0	21	11	.....
25	6.3	20	5.9	.4	8.3	21	9.6	.....
26	10	20	4.8	.7	8.3	19	11	.....
27	8.8	18	4.8	1.2	8.3	19	12	.....
28	8.8	13	3.7	1.9	8.3	16	11	.....
29	13	13	1.9	1.9	8.3	16	11	.....
30	16	13	1.9	1.9	9.6	12	11	.....
31	.....	20	.....	1.9	9.6	.....	11	.....

a Estimated.

NOTE.—These discharges are based on a fairly well defined rating curve.

Monthly discharge of Lebo Creek near Harlowton, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	a 12	738	
February	.....	.....	a 12	666	
March	.....	.....	a 13	799	
April	.....	.....	11	655	A.
May	29	12	18.8	1,160	A.
June	27	1.9	9.26	551	B.
July	5.9	.4	2.78	171	C.
August	9.6	2.8	5.34	328	B.
September	26	9.6	17.8	1,060	B.
October	12	9.6	11	676	B.
November	.....	.....	12.2	726	B.
December	.....	.....	a 10	615	
The year	.....	.....	11.3	8,140	

a Discharge estimated Jan. 1 to Apr. 9; and Nov. 21 to Dec. 31.

NOTE.—Means for January, February, March, and December only approximate.

MILK RIVER BASIN.

DESCRIPTION.

Milk River is formed in the southern part of the Canadian Province of Alberta [1] by the union of two streams, the North Fork and the South Fork, that rise in the undulating foothills of the Rocky Mountains in northeastern Montana, near the international boundary line. For about 100 miles from this junction the Milk flows eastward parallel to and on the northeastern side of the boundary. It then turns to the southeast, passes across the northern part of Montana, and discharges into the Missouri east of Glasgow.

The tributaries of Milk River, except Clear Creek near Yantic, and North Fork at Chinook, are for the most part intermittent streams, but the drainage ways that carry them contain local water pockets which are used as watering places for stock.

From the point at which it leaves Canada and enters Montana to Yantic, 10 miles east of Havre, the Milk is bounded on both sides by high cliffs that rise 200 feet or more above the stream. At Yantic the cliffs recede and become less abrupt and the valley spreads out, and it maintains a width from 3 to 4 miles to its lower end, where it narrows to a mile near Hinsdale. This wider part of the valley was probably the preglacial channel of the Missouri before it was turned aside by the ice sheet and forced to seek a new outlet eastward along the southern face of the glacier.

From the top of the cliffs the country has a rolling aspect, exhibiting no abrupt changes except where tributaries to the main river have eroded deep channels in passing from higher or bench lands to the valley. The general slope of the country is toward the east.

A deposit of glacial drift, varying from a layer so thin as to be unnoticeable to a bed 70 feet thick, covers the greater part of the drainage basin except along the streams, and many small ponds that dry up in summer time are scattered over the area. Most of these ponds occupy shallow depressions with no outlet, and their waters, as a rule, contain salts leached from the soil, and are therefore alkaline. Highly alkaline water was also obtained by a number of wells that have been sunk in the vicinity of Havre and Chinook.

The entire drainage basin lies within the plains section, and is treeless except for a few willows and cottonwoods along the stream.

The mean annual rainfall, which is about 14 inches at Havre, is 19 inches at the extreme western edge of the basin. As a rule, most of this rainfall occurs during the months of May and June. As might be expected in this northern latitude, the streams and lakes are icebound from the last part of November to the first of April.

[1] Beginning July 1, 1909, the Canadian Government maintained stations in the Milk River basin in the Province of Alberta. The data are published in the report of progress of stream measurements for 1909, issued by the department of the interior, Dominion of Canada.

As the rainfall is so scanty, irrigation is necessary for successful cultivation of crops. The United States Reclamation Service has begun construction on an irrigation project that will store the flood water of Milk River, reenforce the discharge by water from St. Mary River, and ultimately reclaim 250,000 acres of land in the lower valley.

Reservoirs for the storage of flood waters are possible at a number of places in the basin, as at Chain Lakes, 30 miles northwest of Havre, and Mud Lake, in Tps. 31 and 32 N., Rs. 31 and 32 E., and at Lake Bowdoin and Lonesome Lake.

Natural power opportunities are wholly lacking in this basin, for the fall of none of the streams is large, and Milk River itself is apt to cease to flow in the late summer and autumn.

The longest run-off record extends back to 1898. The wettest year since that time was 1899 and the driest was 1905. The total flow of the river in the driest year was only one-thirtieth of that of the wettest.

SOUTH FORK OF MILK RIVER NEAR BROWNING, MONT.

This station, which is located at Richard Croff's ranch, about 40 miles northeast of Browning, Mont., and about 6 miles south of the Canadian boundary line, was established April 28, 1905, to obtain data for use in connection with irrigation projects in Milk River Valley.

No storage is used above this station. A number of small ditches divert water to irrigate meadow lands in the river bottom, a considerable amount of this water returning to the stream as seepage and waste water.

The river overflows its banks at a gage height of 12 feet. During the high water of June, 1908, the gage was washed out and was not replaced until July 31, 1908. From high-water marks the stage was found to be 15.4 feet. The flood width was 850 feet and the flood cross section about 2,600 square feet.

On July 31, 1908, a new chain gage and cable were put in at their original locations. The datum of the gage remains the same.

The results are excellent, except during the winter months, when they are affected by ice.

Discharge measurements of South Fork of Milk River near Browning, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 21	W. A. Lamb	73	88	3.35	143
Sept. 16	M. E. McChristie	18	13.5	2.48	17.5

Daily gage height in feet of South Fork of Milk River near Browning, Mont., for 1910.

[R. J. Croff, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	3.10	3.15	2.92	2.50	2.25	2.50	2.60	2.58
2	3.10	3.12	2.92	2.55	2.25	2.55	2.60	2.55
3	3.10	3.05	2.90	2.50	2.20	2.60	2.65	2.55
4	3.00	3.00	2.95	2.55	2.20	2.60	2.65	2.58
5	2.90	3.05	2.97	2.55	2.30	2.70	2.60	2.45
6	3.00	2.98	2.88	2.50	2.28	2.70	2.60	2.60
7	3.28	2.98	2.88	2.55	2.35	2.68	2.60	2.58
8	3.42	3.08	3.50	2.55	2.30	2.75	2.60	2.55
9	3.48	3.15	3.80	2.52	2.32	2.68	2.55	2.58
10	3.52	3.20	3.30	2.55	2.35	2.65	2.55	2.50
11	3.60	3.38	3.10	2.50	2.25	2.70	2.55	2.65
12	3.55	3.35	3.02	2.55	2.30	2.60	2.55	2.65
13	3.55	3.25	2.92	2.50	2.25	2.60	2.55	2.55
14	3.48	3.18	2.85	2.45	2.25	2.55	2.55	2.50
15	3.25	3.35	2.85	2.50	2.30	2.55	2.55	2.50
16	3.20	3.30	2.80	2.40	2.30	2.55	2.55	2.52
17	3.18	3.65	2.82	2.35	2.40	2.50	2.55	2.55
18	3.28	3.55	2.78	2.30	2.35	2.50	2.60	2.68
19	3.30	3.40	2.72	2.30	2.30	2.50	2.65	2.55
20	3.40	3.65	2.75	2.35	2.30	2.45	2.65	2.58
21	3.38	3.50	2.70	2.30	2.25	2.42	2.60	2.65
22	3.28	3.30	2.70	2.35	2.30	2.55	2.55	2.40
23	3.18	3.18	2.75	2.28	2.25	2.60	2.58	2.65
24	3.20	3.10	2.80	2.25	2.30	2.65	2.55	2.80
25	3.32	3.10	2.83	2.30	2.40	2.62	2.60	2.55
26	3.35	3.10	2.70	2.25	2.35	2.75	2.60	2.50
27	3.35	3.08	2.62	2.30	2.35	2.75	2.52	2.50
28	3.30	3.00	2.60	2.22	2.30	2.70	2.58	2.50
29	3.28	3.00	2.58	2.25	2.35	2.68	2.70	2.50
30	3.18	3.03	2.57	2.30	2.40	2.60	2.70	2.50
31	.....	2.95	.....	2.25	2.35	.....	2.60	.....

NOTE.—Ice probably existed during January, February, and December.

Daily discharge, in second-feet, of South Fork of Milk River near Browning, Mont., for 1910.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	94	102	68	23	9	23	32	30
2	94	97	68	28	9	28	32	28
3	94	86	65	23	8	32	37	28
4	79	79	72	28	8	32	37	30
5	65	86	75	28	10	42	32	20
6	79	76	62	23	9.6	42	32	32
7	126	76	62	28	13	40	32	30
8	154	91	172	28	10	47	32	28
9	168	102	246	25	11	40	28	30
10	177	111	130	28	13	37	28	23
11	195	146	94	23	9	42	28	37
12	184	140	82	28	10	32	28	37
13	184	120	68	23	9	32	28	28
14	168	108	58	20	9	28	28	23
15	120	140	58	23	10	28	28	32
16	111	130	52	16	10	28	28	25
17	108	206	55	13	16	23	28	28
18	126	184	50	10	13	23	32	40
19	130	150	44	10	10	23	37	28
20	150	208	47	13	10	20	37	30
21	146	172	42	10	9	17	32	37
22	126	130	42	13	10	28	28	16
23	108	108	47	9.6	9	32	30	37
24	111	94	52	9	10	37	28	52
25	134	94	56	10	16	34	32	28
26	140	94	42	9	13	47	32	23
27	140	91	34	10	13	47	25	23
28	130	79	32	8.4	10	42	30	23
29	126	79	30	9	13	40	42	23
30	108	84	29	10	16	32	42	23
31	.....	72	.....	9	13	.....	32	.....

NOTE.—These discharges are based on a well-defined rating curve.

Monthly discharge of South Fork of Milk River near Browning, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January			a 25	1,540	
February			a 25	1,390	
March			a 65	4,000	
April	195	65	129	7,680	A.
May	208	72	114	7,010	A.
June	246	29	67.8	4,030	A.
July	28	8.4	17.7	1,090	B.
August	16	8	10.9	670	B.
September	47	17	33.3	1,980	B.
October	42	28	31.5	1,940	B.
November	52	16	28.4	1,690	B.
December			a 25	1,540	
The year			47.7	34,600	

a Discharge estimated January, February, March, and December, and the means are therefore only approximate.

MILK RIVER AT HAVRE, MONT.

This station, which is located at the highway bridge over Milk River at Havre, Mont., was established May 15, 1898, to obtain data for use in connection with a storage project for irrigation in Milk River valley. The nearest important tributaries enter about 20 miles east of the station.

The drainage area above Havre is about 7,300 miles, but the entire run-off from this area does not pass Havre, as an elaborate canal system in southern Alberta is supplied by Milk River. The theoretical discharge of the main canal of this system is about 330 second-feet. The Canadian minister of the interior has granted the canal company 500 second-feet of the low-water flow and 1,500 second-feet of the high-water discharge. As the system has not been wholly in operation, the full effect of the diversions on the flow of Milk River has not yet been felt at Havre.

There are no other important irrigation rights above Havre, but farther downstream are five large canal systems supplied directly from Milk River and irrigating about 22,000 acres. The water rights of these various systems have not yet been adjudicated, although preliminary steps have been taken. A suit in behalf of the Fort Belknap Indians was decided in their favor, with the result that they were given a prior right over the other canals to 125 second-feet, the priority of the other rights not being touched upon. Although no provision for storage has been made by the above claimants, the entire unappropriated flow of the stream has been filed upon by the United States Reclamation Service in connection with its Milk River irrigation project, which is now under construction.

A chain gage fastened to the bridge rail on the downstream side is used; its datum has remained the same since the station was established. Measurements may be made from the bridge or by wading.

From the last part of November to the first part of April the river at Havre is frozen entirely over, and in portions of the cross sections it is usually frozen to the bottom.

Frequent discharge measurements are necessary at this station, and even with these the estimates are subject to considerable error. This characteristic is true of the entire river. In dry years the flow ceases entirely and the water stands in pools for several months.

Discharge measurements of Milk River at Havre, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 30	Raymond Richards	122	169	6.25	333
Apr. 30	M. E. McChristie	114	124	5.73	180
May 7	do	124	123	5.70	170
June 20	do	87	72	5.29	72
July 18	W. A. Lamb	21	6.8	4.48	5.2

Daily gage height, in feet, of Milk River at Havre, Mont., for 1910.

[U. S. Weather Bureau, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Sept.	Oct.	Nov.
1	.....	6.1	5.7	5.7	5.0	.....	4.7	4.9
2	8.2	6.1	5.7	5.6	4.9	.....	4.7	4.9
3	8.5	6.0	5.7	5.6	4.9	.....	4.7	4.9
4	8.9	6.0	5.7	5.6	4.9	.....	4.7	4.9
5	8.9	5.9	5.7	5.6	4.9	.....	4.7	4.9
6	8.7	5.9	5.7	5.6	4.9	.....	4.7	4.9
7	8.4	5.8	5.7	5.6	5.0	.....	4.6	4.9
8	8.0	5.8	5.6	5.5	5.0	.....	4.7	4.9
9	7.9	5.8	5.6	5.5	4.9	.....	4.7	4.9
10	7.4	5.8	5.6	5.5	4.9	.....	4.7	4.9
11	7.7	5.6	5.7	5.5	4.9	.....	4.8	5.1
12	7.9	5.6	5.7	5.5	4.9	.....	4.8	5.1
13	7.5	5.5	5.6	5.4	4.9	.....	4.8	5.0
14	7.4	5.5	5.6	5.4	4.9	.....	4.9	5.0
15	7.9	5.7	5.6	5.4	4.8	4.6	4.9	5.0
16	7.6	5.7	5.6	5.3	4.7	4.6	4.9	5.0
17	8.4	5.7	5.6	5.7	4.6	4.7	4.9	5.0
18	8.1	5.9	5.7	5.7	4.5	4.8	4.9	.....
19	7.6	5.9	5.8	5.5	4.5	4.8	4.9	.....
20	7.3	5.8	5.8	5.4	4.4	4.8	4.9	.....
21	7.4	5.8	5.8	5.3	4.3	4.8	4.9	.....
22	7.2	5.8	5.8	5.3	4.3	4.8	4.9	.....
23	7.1	5.7	5.8	5.3	4.3	4.8	4.9	5.0
24	6.9	5.7	5.7	5.3	4.3	4.8	4.9	5.0
25	7.8	6.2	5.9	5.2	4.3	4.9	4.9	5.0
26	6.8	6.2	5.9	5.1	4.2	4.8	4.9	.....
27	6.7	5.8	5.9	5.0	4.2	4.9	4.9	.....
28	6.8	5.8	5.8	5.0	.....	4.8	4.9	.....
29	6.8	5.7	5.8	5.0	.....	4.8	4.9	.....
30	6.6	5.7	5.7	5.0	.....	4.7	4.9	.....
31	6.4	.....	5.7	.....	.....	.....	4.9	.....

NOTE.—Ice Jan. 1 to Mar. 1 and after Nov. 25. River dry from July 28 to Sept. 14.

Daily discharge, in second-feet, of Milk River at Havre, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Sept.	Oct.	Nov.
1	.....	283	161	161	38	.....	11	27
2	1,400	283	161	138	27	.....	11	27
3	1,600	249	161	138	27	.....	11	27
4	1,860	249	161	138	27	.....	11	27
5	1,860	217	161	138	27	.....	11	27
6	1,720	217	161	138	27	.....	11	27
7	1,530	188	161	138	38	.....	7	27
8	1,280	188	138	117	38	.....	11	27
9	1,220	188	138	117	27	.....	11	27
10	920	188	138	117	27	.....	11	27
11	1,100	138	161	117	27	.....	18	51
12	1,220	138	161	117	27	.....	18	51
13	980	117	138	98	27	.....	18	38
14	920	117	138	98	27	.....	27	38
15	1,220	161	138	98	18	7	27	38
16	1,040	161	138	81	11	7	27	38
17	1,530	161	138	161	7	11	27	38
18	1,340	217	161	161	6	18	27	38
19	1,040	217	188	117	6	18	27	38
20	860	188	188	98	4	18	27	38
21	920	188	188	81	2	18	27	38
22	800	188	188	81	2	18	27	38
23	740	161	188	81	2	18	27	38
24	630	161	161	81	2	18	27	38
25	1,160	319	217	65	2	27	27	38
26	575	319	217	51	1	18	27	.....
27	525	188	217	38	1	27	27	.....
28	575	188	188	38	0	18	27	.....
29	575	161	188	38	.....	18	27	.....
30	480	161	161	38	.....	11	27	.....
31	396	.....	161	.....	.....	.....	27	.....

NOTE.—These discharges are based on a well-defined rating curve below 400 second-feet. Above this the curve is an extension. Stream dry July 28 to Sept. 14. Discharge interpolated Nov. 18 to 22.

Monthly discharge of Milk River at Havre, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Ma'mum.	Minimum.	Mean.		
January	.....	.....	[a] 40	2,460	
February	.....	.....	[a] 50	2,780	
March	1,860	396	1,060	65,200	C.
April	319	117	197	11,700	A.
May	217	138	167	10,300	A.
June	161	38	103	6,130	A.
July	38	0	15.3	940	B.
August	0	0	0	0	
September	27	0	9.0	536	C.
October	27	7	20.8	1,280	B.
November	51	27	[a] 34.2	2,040	B.
December	.....	.....	[a] 25	1,540	
The year	.....	.....	143	105,000	

[a] Discharge estimated Jan. 1 to Mar. 1 and Nov. 26 to Dec. 31.

NOTE.—Stream dry July 28 to Sept. 14.

MILK RIVER AT MALTA, MONT.

This station, which is located at the highway bridge at Malta, Mont., was established July 31, 1902, to obtain data for irrigation projects in Milk River valley. The nearest tributaries above the station are West and North forks of Milk River, which enter about 60 miles west of Malta.

The drainage area above is about 14,000 square miles, but the entire run-off does not pass this station, for between Havre and Malta seven irrigation canals, which irrigate about 25,000 acres of land, divert water from Milk River and its tributaries. The United States Reclamation Service has under construction a diversion dam at Dodson, about 17 miles above the station, which diverts water for the irrigation of about 108,000 acres of land in Milk River valley east of Malta. There are two canals, one on each side, with a total discharge of 1,000 second-feet.

The chain gage is fastened to the foot rail on the down side of the bridge. The gage datum has not been changed since the station was established. Measurements are made from the bridge or by wading. From November until April the gage heights are affected by ice, so that estimates of run-off are only approximate. The channel is sandy and shifts during floods.

Discharge measurements of Milk River at Malta, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 29	Raymond Richards	122	297	3.65	1,050
Apr. 27[a]	W. A. Lamb	40	41	1.32	54
May 12[a]	M. E. McChristie	32	20	1.10	39
17[a]	do	34	25	1.22	52
21[a]	do	34	24	1.23	50
24[a]	do	26	38	1.18	47
July 8[a]	do	6	1.2	.50	.9

[a] Made by wading.

Daily gage height, in feet, of Milk River at Malta, Mont., for 1910.

[R. H. Thomas, observer.]

Day.	Apr.	May.	June.	July.	Dec.	Day.	Apr.	May.	June.	July.	Dec.
1	.....	1.1	1.6	0.5	.....	16	1.45	1.2	0.6	0.4	0.5
2	2.65	1.0	1.4	.5	.....	17	1.45	1.3	.6	.4	.5
3	2.65	1.1	1.4	.5	.....	18	1.35	1.1	.6	.4	.....
4	2.45	1.1	1.4	.5	0.2	19	1.25	1.1	.6	.4	.....
5	2.05	1.1	1.3	.5	.2	20	1.05	1.2	.6	.35	.....
6	2.05	1.1	1.3	.5	.2	21	1.05	1.3	.5	.3	.....
7	2.25	1.1	1.3	.5	.2	22	1.05	1.2	.5	.3	.....
8	2.45	1.1	1.1	.5	.3	23	1.25	1.1	.5	.35	.....
9	2.35	1.1	1.0	.5	.5	24	1.25	1.2	.5	.3	.....
10	1.95	1.1	1.0	.5	.6	25	1.25	1.2	.5	.25	.....
11	1.65	1.1	.9	.55	.6	26	1.25	1.2	.5	.25	.....
12	1.45	1.1	.8	.5	.5	27	1.3	1.3	.5	.2	.....
13	1.55	1.1	.8	.5	.5	28	1.3	1.3	.5	.2	.....
14	1.65	1.1	.7	.5	.5	29	1.2	1.4	.5	.15	.....
15	1.55	1.1	.7	.45	.5	30	1.1	1.4	.5	.1	.....
						31	.....	1.6	.....	.05	.....

NOTE.—Ice probably existed to greater or less extent during January, February, and December.

Daily discharge, in second-feet, of Milk River at Malta, Mont., for 1910.

Day.	Apr.	May.	June.	July.	Dec.	Day.	Apr.	May.	June.	July.	Dec.
1	.....	40	116	1	.....	16	88	52	4	0	1
2	472	29	80	1	.....	17	88	65	4	0	1
3	472	40	80	1	.....	18	72	40	4	0	.....
4	382	40	80	1	.....	19	58	40	4	0	.....
5	231	40	65	1	.....	20	34	52	4	0	.....
6	231	40	65	1	.....	21	34	65	1	0	.....
7	301	40	65	1	.....	22	34	52	1	0	.....
8	382	40	40	1	.....	23	58	40	1	0	.....
9	340	40	29	1	1	24	58	52	1	0	.....
10	200	40	29	1	4	25	58	52	1	0	.....
11	126	40	21	2.5	4	26	58	52	1	0	.....
12	88	40	14	1	1	27	65	65	1	0	.....
13	106	40	14	1	1	28	65	65	1	0	.....
14	126	40	8	1	1	29	52	80	1	0	.....
15	106	40	8	0.5	1	30	40	80	1	0	.....
						31	.....	116	.....	0	.....

NOTE.—These discharges are based on a well-defined rating curve. Above 52 second-feet it is the same as the 1909 curve. Stream dry July 16 to Dec. 8.

Monthly discharge of Milk River at Malta, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	[a] 50	3,070	
February	.....	.....	[a] 55	3,050	
March	.....	.....	[a] 1,706	105,000	
April	570	34	166	9,880	A.
May	116	29	50 2	3,090	B.
June	116	1	24 8	1,480	B.
July	2.5	0	.52	32	C.
August	.....	.....	0	0	
September	.....	.....	0	0	
October	.....	.....	0	0	
November	.....	.....	0	0	
December	.....	.....	5	31	
The year	.....	.....	171	126,000	

[a] Discharge estimated Jan. 1 to Apr. 1 and Dec. 1 to 31.

NOTE.—The means for January, February, March, and December are only approximate. Stream dry July 16 to Dec. 8.

MILK RIVER AT HINSDALE, MONT.

This station, which is located at the highway bridge over Milk River about 1 mile from Hinsdale, Mont., a point 46 miles from its junction with Missouri River, was established May 13, 1908, to obtain data for use in connection with irrigation projects in Milk River valley.

Three tributaries enter between Malta and Hinsdale—Beaver Creek from the south and Frenchman and Rock creeks from the north. These streams discharge large volumes of water during the rainy weather in the spring and summer, but they are low or even dry during the fall and winter months.

No diversions are made between Malta and Hinsdale. The United States Reclamation Service has appropriated the flow of the stream

in connection with the Milk River project and will divert it at a point 9 miles east of Hinsdale to irrigate land in lower Milk River valley.

From late in November until the 1st of April the stream is frozen entirely across and to a considerable depth. It is impracticable to keep gage records here during this period.

A chain gage is located on the upstream side of the highway bridge. The datum has remained unchanged. Measurements are made from the bridge or by wading. Channel is gravel and nonshifting.

Discharge measurements of Milk River at Hinsdale, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq.-ft.*	*Feet.*	*Sec.-ft.*
Mar. 28	Raymond Richards	136	1,290	6.57	2,830
Apr. 28	W. A. Lamb	64	151	2.08	158
May 18	M. E. McChristie	65	131	1.71	86
28	.....do	63	130	1.68	81
July 8	.....do	18	7.7	.89	9
25	.....do	.....	.....	.65	*a* 3.5

a Discharge estimated.

Daily gage height, in feet, of Milk River at Hinsdale, Mont., for 1910.

[Goldie Wooldridge, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	4.6	1.8	1.7	1.0	0.5	1.4	0.5	0.65
2	.....	4.3	1.8	1.8	1.0	.5	1.2	.5	.65
3	.....	4.3	1.8	1.7	1.0	.5	1.1	.5	.6
4	.....	4.75	1.8	1.7	1.0	.5	1.1	.45	.65
5	.....	4.3	1.8	1.8	1.0	.45	1.0	.5	.65
6	.....	4.15	1.8	1.8	1.0	.5	.8	.5	.65
7	.....	3.7	1.8	1.7	1.0	.45	.7	.5	.6
8	.....	3.55	1.8	1.7	1.0	.45	.75	.5	.6
9	.....	3.4	1.8	1.8	1.0	.4	.7	.5	.6
10	.....	3.1	1.7	1.8	.9	.4	.7	.55	.6
11	.....	4.1	1.65	1.7	.9	.4	.7	.6	.6
12	.....	3.6	1.6	1.6	.8	.4	.65	.6	.6
13	.....	3.1	1.65	1.5	.8	.4	.65	.6	.....
14	.....	3.0	1.5	1.5	.8	.45	.6	.55	.....
15	.....	2.7	1.5	1.5	.8	.45	.6	.5	.....
16	.....	2.4	1.45	1.5	.8	2.15	.6	.5	.....
17	.....	4.3	1.5	1.5	.7	2.25	.6	.5	.....
18	.....	3.2	1.7	1.7	.7	1.8	.6	.55	.....
19	.....	2.3	1.45	1.6	.7	1.6	.6	.6	.....
20	.....	2.3	1.45	1.5	.7	1.4	.6	.6	.....
21	.....	2.3	1.4	1.5	.7	1.4	.6	.55	.....
22	.....	2.2	1.4	1.4	.7	1.35	.55	.55	.....
23	.....	2.1	1.4	1.3	.7	1.3	.5	.55	.....
24	.....	2.0	1.3	1.2	.65	1.1	.5	.6	.....
25	.....	2.0	1.3	1.1	.65	.9	.5	.6	.....
26	.....	1.9	1.5	1.1	.55	.9	.5	.6	.....
27	.....	1.85	1.4	1.1	.55	.8	.5	.6	.....
28	6.6	2.1	1.7	1.0	.55	.85	.55	.6	.....
29	6.6	1.8	1.7	1.0	.5	.8	.55	.6	.....
30	5.6	1.7	1.7	1.5	.55	.8	.5	.6	.....
31	4.75	.....	1.7	.....	.45	.75	.....	.65	.....

NOTE.—Ice probably existed during January and February and after Nov. 12. There was a slight freeze Oct. 28. Gage heights Oct. 28 to Nov. 12 are probably slightly affected.

Daily discharge, in second-feet, of Milk River at Hinsdale, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		1,380	103	86	13	1.3	44	1.3	3.6
2		1,180	103	103	13	1.3	26	1.3	3.6
3		1,180	103	86	13	1.3	19	1.3	2.8
4		1,490	103	86	13	1.3	19	.6	3.6
5		1,180	103	103	13	.6	13	1.3	3.6
6		1,090	103	103	13	1.3	6.5	1.3	3.6
7		830	103	86	13	.6	4.5	1.3	2.8
8		750	103	86	13	.6	5.5	1.3	2.8
9		675	103	103	13	0	4.5	1.3	2.8
10		535	86	103	9	0	4.5	2.0	2.8
11		1,060	78	86	9	0	4.5	2.8	2.8
12		775	70	70	6.5	0	3.6	2.8	2.8
13		535	78	56	6.5	0	3.6	2.8	
14		490	56	56	6.5	.6	2.8	2.0	
15		370	56	56	6.5	.6	2.8	1.3	
16		256	50	56	6.5	179	2.8	1.3	
17		1,180	56	56	4.5	207	2.8	1.3	
18		580	86	86	4.5	103	2.8	2.0	
19		222	50	70	4.5	70	2.8	2.8	
20		222	50	56	4.5	44	2.8	2.8	
21		222	44	56	4.5	44	2.8	2.0	
22		192	44	44	4.5	39	2.0	2.0	
23		166	44	34	4.5	34	1.3	2.0	
24		143	34	26	3.6	19	1.3	2.8	
25		143	34	19	3.6	9	1.3	2.8	
26		122	56	19	2.0	9	1.3	2.8	
27		112	44	19	2.0	6.5	1.3	2.8	
28	2,850	166	86	13	2.0	7.7	2.0	2.8	
29	2,850	103	86	12	1.3	6.5	2.0	2.8	
30	2,100	86	86	56	2.0	6.5	1.3	2.8	
31	1,490		86		.6	5.5		3.6	

NOTE.—These discharges are based on a well-defined curve, the 1909 rating table being used above 295 second-feet.

Monthly discharge of Milk River at Hinsdale, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January			*a* 55	3,380	
February			*a* 60	3,330	
March			*a* 2,500	154,000	
April	1,380	86	581	34,600	B.
May	103	34	73.8	4,540	A.
June	103	13	63.1	3,750	A.
July	13	.6	6.97	429	B.
August	207	0	25.8	1,590	B.
September	44	1.3	6.48	386	B.
October	3.6	.6	2.07	127	B.
November	3.6		*a* 2.76	164	C.
December			*a* 3.0	184	
The year			281	207,000	

a Discharge estimated by comparison with other Milk River stations Jan. 1 to Mar. 27 and Nov. 13 to Dec. 31.

NOTE.—The means for January, February, March, and December are only approximate.

NORTH FORK OF MILK RIVER NEAR CHINOOK, MONT.

This station, which is located about 4½ miles north of Chinook, Mont., and about 7 miles above the junction of North Fork with Milk River, was established April 22, 1905, to obtain data for use in connection with irrigation projects in Milk River valley.

No storage is used on this stream. Three canals, which divert an aggregate of about 20 second-feet, take out above the station. Several small pumping plants, which supply water for irrigating the bottom land along the river valley, also operate above the station. Below the station the Matheson and Cook canals divert water for irrigating land in Milk River valley near the mouth of North Fork. The aggregate appropriation of these canals is 78 second-feet.

The results at this station may be considered reliable, as a fair rating curve has been obtained. Ice during the winter months makes gage readings impracticable. A chain gage is located on the left bank near the house of the observer. The datum of the gage has remained the same since the station was established in 1905. Measurements may be made by wading or at the cable near the gage.

The greater part of the run-off occurs during floods caused by heavy rains in the spring and early summer. The stream often goes dry in the fall. Channel sandy and shifting.

Discharge measurements of North Fork of Milk River near Chinook, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 30	Raymond Richards	44	72	1.64	127
May 3[a]	M. E. McChristie	36	28	.63	25
7[a]	do	16	24	.48	14
13[a]	do	16	24	.43	11
June 20[a]	do	6	1.1	.05	.4

[a] Made by wading.

Daily gage height, in feet, and discharge, in second-feet, of North Fork of Milk River near Chinook, Mont., for 1910.

Day.	Mar.		Apr.		May.		June.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			1.34	87	0.76	31	0.30	7.0
2			1.28	79	.68	26		6.7
3			1.32	84	.64	23		6.4
4			1.28	79	.61	22	.27	6.1
5			1.23	74	.55	18		5.6
6			1.18	69	.52	17		5.1
7	2.07	209	1.12	63	.50	16	.22	4.6
8	2.35	275	1.20	71	.48	15		4.2
9	2.12	221	1.27	79	.46	14		3.8
10	2.04	203	1.14	65	.43	12	.17	3.4
11	2.04	203	1.30	82	.44	13		3.0
12	3.32	570	1.22	73	.44	13		2.7
13	4.37	954	1.21	72	.44	13	.12	2.4
14	4.47	991	1.18	69	.42	12		2.0
15	3.72	713	1.10	61	.44	13		1.7
16	4.07	843	1.02	53	.52	17	.07	1.4
17	3.62	677	1.00	51	.52	17		1.1
18	3.09	491	.98	49	.50	16		.8
19	2.41	291	.94	46	.47	14		.6
20	2.27	256	.92	44	.46	14	.02	.4

Daily gage height, in feet, and discharge in second-feet, of North Fork of Milk River near Chinook, Mont., for 1910—Continued.

Day.	Mar.		Apr.		May.		June.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
21	2.64	352	0.92	44	0.43	12	.....	.....
22	2.54	325	.90	42	.43	12	.....	.....
23	2.37	280	.89	41	.50	16	.....	.....
24	2.27	256	.92	44	.48	15	.....	.....
25	2.22	244	.90	42	.46	14	.....	.....
26	2.04	203	.86	39	.43	12	.....	.....
27	1.87	168	.81	35	.41	12	.....	.....
28	1.78	151	.80	34	.38	10	.....	.....
29	1.64	127	.80	34	.33	8.2	.....	.....
30	1.52	110	.78	40	.32	7.8	.....	.....
31	1.40	94	.....	.....	.32	7.8	.....	.....

NOTE.—There was probably ice during January and February. These discharges are based on the 1910 rating curve up to 194 second-feet, which is well defined. Above 194 second-feet 1909 rating is used. Discharges interpolated in June for days having no gage record. Stream dry June 21 to Dec. 31.

Monthly discharge of North Fork of Milk River near Chinook, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	[a]10	614	
February	.....	.....	[a]12	666	
March	991	.....	[a]332	20,400	B.
April	87	34	58.2	3,460	B.
May	31	7.8	14.9	916	B.
June	7	0	2.3	137	C.
July	.....	.....	0	0	
August	.....	.....	0	0	
September	.....	.....	0	0	
October	.....	.....	0	0	
November	.....	.....	0	0	
December	.....	.....	0	0	
The year	.....	.....	37.5	26,200	

[a] Discharge estimated Jan. 1 to Mar. 6.

NOTE.—The stream was dry from June 21 to the end of the year. The means for January and February are only approximate.

BEAVER CREEK NEAR SACO, MONT.[1]

Beaver Creek rises in the Little Rocky Mountains, flows northeastward, and enters Milk River near Hinsdale, Mont.

The gaging station, which was established December 31, 1903, to obtain data for use in connection with irrigation projects in Milk River Valley, is located at Craig's ranch, about 18 miles from Malta, 3 miles south of Ashfield, Mont., and near Saco, Mont., the nearest post office.

The only diversion is that for the irrigation of land bordering the stream. The water is diverted by small ditches leading from the stream and by small pumping plants near the banks.

[1] This station was called "Beaver Creek near Ashfield, Mont.," in earlier reports.

The entire run-off from this area does not pass the station. At medium and high stages a second channel, known as Beaver Creek Overflow, leaves the stream above the station, follows a depression to the west of the main channel, and reenters at a point some distance below the gage. Records are kept of the flow of this channel.

A staff gage was first established at Bridge No. 455 of the Great Northern Railway, half a mile west of Ashfield, Mont. It was moved to its present location 2½ miles upstream December 31, 1903. Measurements are made from a cable or by wading. The stream carries but little water except at the times of the spring floods or heavy rains. During the summer months the channel is obstructed by a dense growth of weeds and willows, which have to be cleared out occasionally, thus making it a difficult matter to procure a permanent rating. The results therefore are only fair.

The following estimate of discharge was made by W. A. Lamb:

April 27, 1910: Gage height, −0.35 foot; discharge, 1.0 second-foot.

Daily gage height, in feet, and discharge, in second-feet, of Beaver Creek near Saco, Mont., for 1910.

[Mrs. W. P. Craig, observer.]

Day.	Mar.		Apr.		May.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			1.35	34	−0.4	0.5
2			1.35	34	−.4	.5
3			1.35	34	−.4	.5
4			1.25	30	−.5	0
5			1.25	30	−.5	0
6			1.65	42	−.5	0
7			2.1	56	−.5	0
8			2.15	58		
9			1.95	52		
10			1.25	30		
11			1.0	23		
12			.55	13		
13	3.75	130	.35	9		
14	3.65	124	.05	3.5		
15	3.5	116	.05	3.5		
16	3.35	108	.05	3.5		
17	3.3	106		3.5		
18	2.85	86		3.5		
19	2.65	78		3.5		
20	2.25	62		3.0		
21	2.15	58		3.0		
22	1.85	48	0	3.0		
23	1.85	48		2.5		
24	1.85	48		2.0		
25	1.7	44		1.5		
26	1.6	41		1.0		
27	1.5	38		.9		
28	1.4	35	−.35	.8		
29	1.35	34	−.4	.5		
30	1.35	34	−.4	.5		
31	1.35	34				

NOTE.—There probably was ice during January and February. The stream began to flow Mar. 5, but no gage heights were kept until Mar. 13. The stream was dry from May 4 to the end of the year with the exception of Aug. 13 to 16, when a little flow occurred. Gage heights for these days were: Aug. 13, 1.0 foot; Aug. 14, 0.7 foot; Aug. 15, 0.4 foot; Aug. 16, 0.15 foot. The discharges were obtained from a well-defined rating curve. Discharges interpolated Apr. 17 to 21 and 23 to 27. Discharge Aug. 13, 25 second-feet; Aug. 14, 16 second-feet; Aug. 15, 10 second-feet; Aug. 16, 5 second-feet.

Monthly discharge of Beaver Creek near Saco, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March		0	a170	10,500	C.
April	34	.5	15.1	898	B.
May	.5	0	.05	3	D.
June	0	0	0	0	
July	0	0	0	0	
August	23	0	1.74	107	D.

a Mar. 1–12 estimated on basis of high-water marks noted by the observer.

BEAVER CREEK OVERFLOW NEAR BOWDOIN, MONT.

This station which was established June 29, 1903, discontinued August 30, 1906, and reestablished May 2, 1908, is located at John Turmell's ranch, 14 miles from Malta, Mont.

The flow of this channel must be added to that at the Beaver Creek station to get the total flow from the drainage area. Water flows into this channel only when Beaver Creek is high; the remainder of the season water is standing in pools, and fluctuations in water level are due wholly to local rains and evaporation.

The datum of the staff gage has remained unchanged. Flood measurements are made at a bridge half a mile below the gage. Low-water measurements are made near the gage by wading.

The following observation was made by W. A. Lamb:

April 27, 1910: Gage height, 3.12 feet; discharge, 0 second-feet (stream dry).

Daily gage height, in feet, of Beaver Creek overflow near Bowdoin, Mont., for 1910.

[John Turmell, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		3.15	3.0	2.2	1.7	1.2	2.9
2		3.15	3.0	2.2	1.7	1.2	2.9
3		3.15	2.9	2.2	1.7	1.2	2.9
4		3.15	2.9	2.2	1.7	1.2	2.9
5		3.05	2.8	2.2	1.7	1.2	2.9
6		3.05	2.8	2.2	1.6	1.1	2.8
7		4.55	2.8	2.1	1.6	1.1	2.8
8		4.35	2.8	2.1	1.6	1.1	2.8
9		4.15	2.7	2.1	1.6	1.1	2.8
10		4.05	2.7	2.1	1.6	1.1	2.7
11		3.95	2.7	2.1	1.6	1.0	2.7
12		3.85	2.7	2.1	1.5	1.0	2.7
13	6.45	3.75	2.6	2.1	1.5	1.75	2.7
14	6.05	3.65	2.6	2.0	1.5	3.1	2.7
15	5.55	3.55	2.6	2.0	1.5	3.1	2.6
16	5.05	3.45	2.6	2.0	1.5	3.1	2.6
17	4.55	3.45	2.6	2.0	1.5	3.1	2.6
18	4.15	3.45	2.5	2.0	1.5	3.0	2.6
19	3.85	3.35	2.5	2.0	1.4	3.0	2.6
20	3.75	3.35	2.5	2.0	1.4	2.9	2.6
21	3.75	3.35	2.4	1.9	1.4	2.9	2.5
22	3.65	3.25	2.4	1.9	1.4	2.8	2.5
23	3.55	3.25	2.4	1.9	1.4	2.8	2.5
24	3.45	3.25	2.4	1.9	1.4	2.8	2.5
25	3.35	3.15	2.4	1.8	1.3	2.7	2.5
26	3.25	3.15	2.4	.....	1.3	2.7	2.4
27	3.25	3.2	2.3	.....	1.3	2.7	2.4
28	3.25	3.2	2.3	.....	1.3	2.7	2.4
29	3.25	3.1	2.3	.....	1.3	3.0	2.4
30	3.25	3.1	2.3	.....	1.3	3.0	2.4
31	3.15	.....	2.3	.....	1.2	3.0	.....

NOTE.—This stream began to flow about Mar. 5. No gage heights were kept during the period Mar. 5 to 12. There was no flow after Mar. 20, excepting Apr. 7 to 12, as the water was standing in pools. Fluctuation of water surface due to local rains and evaporation.

Daily discharge, in second-feet, of Beaver Creek overflow near Bowdoin, Mont., for 1910.

Day.	Mar.	Apr.	Day.	Mar.	Apr.	Day.	Mar.	Apr.
1		0	11		0.6	21	0	
2		0	12		.1	22	0	
3		0	13	140	0	23	0	
4		0	14	100		24	0	
5		0	15	60		25	0	
6		0	16	30		26	0	
7		10	17	10		27	0	
8		6.1	18	2.9		28	0	
9		2.9	19	.1		29	0	
10		1.6	20	0		30	0	
						31	0	

NOTE.—These discharges are based on a fairly well defined rating curve.

Monthly discharge of Beaver Creek overflow near Bowdoin, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
March		0	75.6	4,650
April	10	0	.70	42

NOTE—Mar. 5–12 estimated on basis of high water marks and statements made by observer. There was practically no flow during balance of year. These estimates are approximate. Total acre-feet for year, 4,692.

PORCUPINE CREEK AT NASHUA, MONT.

Porcupine Creek rises in the northern part of Valley County, Mont., flows southward, forming the west boundary of the Fort Peck Indian Reservation, and enters Milk River at Nashua, a point about 5 miles from the junction of Milk River with the Missouri.

The drainage area comprises a strip of rolling prairie about 40 miles long, extending but a short distance back from the narrow valley formed by the stream. Forests, except for willows and cottonwoods along the banks of the stream, are lacking.

The greater part of the run-off comes from the melting snow in the early spring and from heavy rains during the summer. In the late summer and winter the stream is dry. The annual rainfall is about 13 inches. The water of this stream is neither diverted nor stored.

The only gaging station is at the road crossing at Nashua. It was established July 11, 1908, to obtain data for an irrigation project under construction by the United States Reclamation Service for the Fort Peck Indians.

Measurements are made by wading near the staff gage, which is nailed securely to a tree on the right bank of the stream at the road crossing.

Discharge measurements of Porcupine Creek at Nashua, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 27	Raymond Richards	39	258	10.15	490
May 9	M. E. McChristie	14	5.3	2.1	6.8

Daily gage height, in feet, of Porcupine Creek at Nashua, Mont., for 1910.

[Rosella Duncan, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Day.	Mar.	Apr.	May.	June.	July.
1		5.0	2.2	1.3	1.9	16	9.3	3.2	2.0	2.2	1.4
2		4.2	2.1	1.2	1.9	17	9.4	3.2	2.0	2.2	1.4
3		4.3	2.1	1.2	1.9	18	9.5	3.2	2.0	2.2	1.3
4		5.0	2.1	1.2	1.8	19	9.5	3.1	1.9	2.2	1.3
5		7.0	2.0	1.2	1.8	20	8.7	3.0	1.9	2.2	1.2
6		7.0	2.0	1.3	1.8	21	7.7	3.0	1.9	2.2	1.1
7		6.8	2.0	1.5	1.8	22	7.7	2.9	1.8	2.2	1.0
8		6.5	2.0	1.7	1.7	23	8.7	2.8	1.8	2.2	1.0
9		5.8	2.0	1.9	1.7	24	11.0	2.8	1.8	2.2	1.0
10		5.7	2.0	2.0	1.7	25	9.4	2.6	1.7	2.2	1.0
11		5.2	2.0	2.0	1.7	26	9.2	2.4	1.7	2.1	1.0
12		4.8	2.0	2.0	1.6	27	10.3	2.4	1.6	2.0	.8
13	8.9	4.3	1.9	2.0	1.5	28	10.2	2.3	1.6	2.0	.4
14	9.0	3.8	1.9	2.2	1.5	29	10.0	2.3	1.6	1.9	
15	9.1	3.4	1.9	2.2	1.4	30	9.0	2.2	1.4	1.9	
						31	7.0		1.3		

NOTE.—Water was standing in pools from about July 12 to 28. Stream dry July 29. Ice probably existed during January and February.

Daily discharge, in second-feet, of Porcupine Creek at Nashua, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Day.	Mar.	Apr.	May.	June.	July.
1		116	10	0	2.8	16	425	40	4.2	10	0
2		80	7	0	2.8	17	435	40	4.2	10	0
3		84	7	0	2.8	18	445	40	4.2	10	0
4		116	7	0	.6	19	445	37	2.8	10	0
5		240	4.2	0	.6	20	371	34	2.8	10	0
6		240	4.2	0	.6	21	292	34	2.8	10	0
7		226	4.2	0	.6	22	292	31	.6	10	0
8		205	4.2	.1	.1	23	371	28	.6	10	0
9		161	4.2	2.8	.1	24	610	28	.6	10	0
10		155	4.2	4.2	.1	25	435	22	.1	10	0
11		126	4.2	4.2	.1	26	415	16	.1	7	0
12		106	4.2	4.2	0	27	531	16	0	4.2	0
13	387	84	2.8	4.2	0	28	520	13	0	4.2	0
14	396	64	2.8	10	0	29	498	13	0	2.8	0
15	405	58	2.8	10	0	30	396	10	0	2.8	0
						31	292		0		0

NOTE.—These discharges are based on a fairly well-defined rating curve. Water standing in pools July 12 to 28, no flow; dry July 29.

Monthly discharge of Porcupine Creek at Nashua, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	610	0	[a] 296	18,200	B.
April	240	10	82.1	4,890	B.
May	10	0	31.0	1,910	B.
June	10	0	5.36	319	B.
July	2.8	0	.36	22	C.
The year				25,300	

[a] Discharge estimated Mar. 1 to 12.

NOTE.—There was little or no flow the rest of the year, water standing in pools or creek dry.

PRIVATE CANALS IN MILK RIVER VALLEY.

DESCRIPTION.

Since 1905 a number of stations have been maintained on private canals in Milk River valley for the purpose of ascertaining the extent of private water rights. With the exception of Rock Creek Canal, which is near Hinsdale, in Valley County, these canals are located in Chouteau County and are used to irrigate lands in the vicinity of Harlem and Chinook.

The canals are all built on small grades and in soil which is easily eroded. In many of them silt has been deposited, and nearly all of them contain a growth of weeds and moss. At low stages the water is uniformly sluggish. In order to divert water into the laterals checks are erected in the main canals, and these checks often produce back-water effects for long distances above. They were put up under a great variety of conditions, and as a result velocities are found to differ widely at the same gage height during the season. In order to establish the correct relation between gage height and discharge it is necessary to make several rating curves for the same canal station. Frequent discharge measurements are necessary to obtain reliable results. Staff gages are located on all canals and most measurements are made by wading.

COOK CANAL NEAR CHINOOK, MONT.

This station, which was established April 10, 1905, is located about one-half mile above a small wooden highway bridge on the road running parallel to the Great Northern Railway, about 3 miles east of Chinook.

Discharge measurements are made from the highway bridge.

Discharge measurements of Cook canal near Chinook, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet.*	*Sec.-ft.*
Apr. 29[a]	M. E. McChristie	13	34	3.11	21
May 6[a]	do	13	27	2.60	13
16	do	14	27	2.45	9.7
20	do	16	34	2.57	15
25	do	14	27	2.54	9.7
June 4	do	8	13	1.95	3.5

[a] Made from south side of footbridge.

Daily gage height, in feet, and discharge, in second-feet, of Cook canal near Chinook, Mont., for 1910.

[Berto Snedecar, observer.]

Day.	Apr.		May.		June.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1				18.5	2.05	4.4
2			2.95	18.5	2.0	4.0
3			2.9	17.7	1.95	3.5
4			2.8	16.1	1.95	3.5
5			2.7	14.6	1.5	.7
6			2.6	13.0	1.45	.5
7			2.5	11.3	1.3	.2
8			2.4	9.6	1.3	.2
9			2.3	7.8	1.2	
10			2.3	7.8	1.15	
11			2.35	8.4	1.1	
12			2.3	7.8	1.05	
13			2.3	7.8	1.0	
14			2.3	7.8		
15		21	2.35	8.4		
16		21	2.5	9.8		
17		21	2.5	9.8		
18		21	2.6	15.4		
19		21	2.6	15.4		
20		21	2.6	15.4		
21		21	2.5	9.8		
22		21	2.45	9.0		
23		21	2.4	8.2		
24		21	2.4	8.2		
25		21	2.5	9.7		
26		21	2.45	8.7		
27		21	2.4	8.1		
28		21	2.3	7.0		
29		21	2.25	6.5		
30		21	2.15	5.4		
31			2.1	4.9		

NOTE.—Canal not running Jan. 1 to Apr. 14, nor June 9 to Dec. 31. The discharges were obtained by the indirect method for shifting channels. Discharges April 15 to May 1 were estimated from known condition of canal regulation.

Monthly discharge of Cook canal near Chinook, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
Apr. 15–30	21	21	[a] 21	666
May	18.5	4.9	10.5	646
June 1–8	4.4	.2	2.12	34

[a] Estimated.

MATHESON CANAL NEAR CHINOOK, MONT.

This station, which was established April 10, 1905, is located at a footbridge 200 feet below the head gate near the main road, 3½ miles east of Chinook.

Discharge measurements of Matheson canal near Chinook, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 29	M. E. McChristie	9	7.9	2.18	4.3
May 6	do	7.5	5.3	2.00	2.5
16	do	5	4.8	1.90	1.9
20	do	2.5	2.4	1.84	1.0
25	do	4	4.1	1.88	1.2

NOTE.—All measurements were made from footbridge.

Daily gage height, in feet, and discharge, in second-feet, of Matheson canal near Chinook, Mont., for 1910.

[Mrs. Winnie Sisson, observer.]

Day.	Apr.		May.		June.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			2.25	5.2	1.75	0.7
2			2.00	2.5	1.7	.5
3			1.9	1.6	1.7	.5
4			1.9	1.6	1.7	.5
5			1.9	1.6	2.3	5.8
6			2.0	2.5	2.3	5.8
7			1.9	1.6	2.3	5.8
8			1.8	.9	2.3	5.8
9			2.0	2.5	2.0	2.5
10			2.0	2.5	2.0	2.5
11			2.0	2.5	2.0	2.5
12			2.0	2.5	2.0	2.5
13			2.0	2.5	1.9	1.6
14			2.0	2.5	1.85	1.2
15			2.0	2.5	1.7	.5
16			1.9	1.6	1.7	.5
17			1.9	1.6	1.3	
18		3	1.9	1.6	1.3	
19		3	1.9	1.6	1.3	
20		3	1.8	.9	1.3	
21		3	1.8	.9	1.3	
22		4	1.8	.9	1.3	
23		4	1.8	.9		
24		4	1.8	.9		
25		4	1.9	1.6		
26		4	1.9	1.6		
27		5	1.8	.9		
28		5	1.8	.9		
29		5	1.8	.9		
30		5	1.8	.9		
31			1.8	.9		

NOTE.—Canal not running Jan. 1 to Apr. 17 nor June 17 to Dec. 31. Water standing in canal June 17 to 22. Discharges based on a fairly well defined rating curve. Discharges Apr. 18 to 30 were estimated from known conditions of regulation.

Monthly discharge of Matheson canal near Chinook, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
Apr. 18–30	5.0	3.0	[a]4.0	103
May	5.2	.9	1.73	106
June 1–16	5.8	.5	2.45	78

[a] Estimated.

HARLEM CANAL NEAR ZURICH, MONT.

This station, which was established in June, 1903, is located about 500 feet below the head gates of the canal, 1½ miles southeast of the Great Northern Railway section house at Zurich. It is reached by driving from Chinook.

Discharge measurements of Harlem canal near Zurich, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 23[a]	M. E. McChristie	19	39	2.65	52
May 6	do	19	37	2.60	52
16	do	19	42	2.95	60
20	do	20	47	3.10	62
20	do	20	47	3.10	65
25	do	18	46	3.09	60
25	do	18	46	3.09	63
June 4	do	18	32	1.83	38

[a] Made from highway bridge 2 miles below gage.

NOTE.—All measurements after Apr. 29 were made at one section between gage and head gates.

Daily gage height, in feet, and discharge, in second-feet, of Harlem canal near Zurich, Mont., for 1910.

[Joel Lean, observer.]

Day.	Mar.		Apr.		May.		June.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			3.0	62	2.7	54	2.6	51
2			3.0	62	2.6	51	2.6	51
3			2.9	59	2.7	54	2.6	51
4			2.9	59	2.7	54	2.2	44
5			2.8	56	2.7	54	2.1	42
6			2.9	59	2.7	54	2.1	42
7			2.9	59	2.8	56	2.2	44
8			2.9	59	2.8	56	2.2	44
9			2.7	54	2.8	56	2.2	44
10	2.9	59	2.7	54	2.7	54	2.1	42
11	3.0	62	2.6	51	2.6	51		
12	3.0	62	2.8	56	2.6	51		
13	3.1	65	3.0	62	2.8	56		
14	3.0	62	3.1	65	3.0	62		
15	3.1	65	3.1	65	3.0	62		
16	3.2	67	3.2	67	2.95	60		
17	3.1	65	3.2	67	3.0	62		
18	3.1	65	3.2	67	3.2	67		
19	3.0	62	3.1	65	3.1	65		
20	3.0	62	3.1	65	3.1	65		

Daily gage height, in feet, and discharge, in second-feet, of Harlem canal near Zurich, Mont., for 1910—Continued.

Day.	Mar.		Apr.		May.		June.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
21	2.9	59	3.1	65	3.25	69	.....	.....
22	2.9	59	3.1	65	3.1	65	.....	.....
23	2.8	56	3.0	62	3.0	62	.....	.....
24	2.8	56	3.0	62	3.1	65	.....	.....
25	2.9	59	3.0	62	3.05	63	.....	.....
26	2.8	56	2.9	59	3.2	67	.....	.....
27	2.9	59	2.9	59	3.0	62	.....	.....
28	3.0	62	2.8	56	3.0	62	.....	.....
29	3.0	62	2.7	54	2.9	59	.....	.....
30	3.0	62	2.7	54	2.85	57	.....	.....
31	3.1	65	.....	.....	2.8	56	.....	.....

NOTE.—Canal not running Jan. 1 to Mar. 9, nor from June 11 to Dec. 31. These discharges are based on a fairly well defined rating curve.

Monthly discharge of Harlem canal near Zurich, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
Mar. 10–31	67	56	61.4	2,680	B.
April	67	51	60.4	3,590	B.
May	69	51	59.1	3,630	B.
June 1–10	51	42	45.5	903	B.

AGENCY DITCH NEAR HARLEM, MONT.

This station, which was established July 14, 1905, is located at the highway bridge, about one-fourth mile below the head gate. It is reached by driving south from Harlem, Mont.

No gage heights were observed regularly during 1910.

Discharge measurements of Agency ditch near Harlem, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 4	M. E. McChristie	21	57	4.45	60
May 14	....do	16	18	2.05	26
June 6	....do	19	49	3.75	40
22	....do	22	78	5.15	48
July 9	....do	22	77	5.20	29
18	W. A. Lamb	20	56	4.95	15

Daily discharge, in second-feet, of Agency ditch near Harlem, Mont., for 1910.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1	.....	60	.....	40	16	60	.....	40	18
2	.....	60	40	40	17	60	.....	40	18
3	.....	60	40	40	18	60	.....	40	16
4	.....	60	40	40	19	60	.....	40	16
5	.....	60	40	40	20	60	.....	40	16
6	.....	60	40	35	21	60	.....	40	16
7	.....	60	40	35	23	60	.....	48	16
8	60	60	40	31	23	60	.....	48	16
9	60	60	40	29	24	60	.....	48	16
10	60	.....	10	29	25	60	.....	48	16
11	60	.....	10	29	26	60	.....	48	16
12	60	.....	10	25	27	60	.....	48	16
13	60	.....	10	25	28	60	.....	45	.....
14	60	.....	10	22	29	60	.....	45	.....
15	60	.....	40	20	30	60	.....	45	.....

NOTE.—These discharges are based on actual measurements and the following note, which was obtained from the irrigation engineer at the agency: "Canal was opened Apr. 8, and remained constant until May 10, when it was shut down for repairs. Water turned on June 2 and was constant until June 9, when the gates were partly closed. June 10 to 14, discharge estimated. Gates opened June 15; same discharge as before being closed. June 22 gates raised, also flush boards on waste gate. Since June 30 discharge decreased on account of river falling. Gates closed July 27."

Monthly discharge of Agency ditch near Harlem, Mont., for 1910.

Month.	Discharge in second-feet (mean).	Run-off (total in acre-feet).
Apr. 8–30	60	2,740
May 1–9	60	1,070
June 2–30	37	2,130
July 1–27	25	1,340

FORT BELKNAP CANAL NEAR CHINOOK, MONT.

This station, which was established June 21, 1903, is located at the highway bridge, about 500 feet below the head gates of the canal, 8 miles east of Chinook.

The high water of June, 1908, washed out both the bridge and the gage. A new gage was installed on June 27, 1908, at a different datum, within a few feet of the site of the old gage.

A new bridge was built about one-fourth mile upstream from the site of the old one. Measurements can be made from this bridge only when the canal is running full. Wading measurements are made at a section about 300 feet downstream from the gage at the bridge.

Discharge measurements of Fort Belknap canal near Chinook, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 30	M. E. McChristie	48	65	2.56	66
May 5	do	48	69	2.62	68
13	do	48	69	2.65	69
19	do	42	61	2.64	62
26	do	49	75	2.75	81
June 7	do	49	75	2.70	72

Daily gage height, in feet, and discharge, in second-feet, of Fort Belknap canal near Chinook, Mont., for 1910.

[Bruce Glenn, observer.]

Day.	May.		June.		Day.	May.		June.	
	Gage height.	Discharge.	Gage height.	Discharge.		Gage height.	Discharge.	Gage height.	Discharge.
1	2.60	67	2.70	75	16	2.65	62	.....	.....
2	2.60	67	2.65	72	17	2.70	62	.....	.....
3	2.60	67	2.65	72	18	2.68	62	.....	.....
4	2.60	67	2.65	72	19	2.65	62	.....	.....
5	2.60	67	2.65	72	20	2.65	62	.....	.....
6	2.60	67	2.65	72	21	2.65	62	2.40	56
7	2.65	70	2.65	72	22	2.65	62	2.45	59
8	2.65	70	2.65	72	23	2.70	73	2.45	59
9	2.60	67	2.60	67	24	2.70	73	2.45	59
10	2.60	67	2.60	67	25	2.75	81	2.45	59
11	2.60	67	2.60	67	26	2.75	81	.....	.....
12	2.60	67	.....	.....	27	2.75	81	.....	.....
13	2.60	67	.....	.....	28	2.75	81	.....	.....
14	2.60	67	.....	.....	29	2.70	75	.....	.....
15	2.60	67	.....	.....	30	2.70	75	.....	.....
					31	2.60	67	.....	.....

NOTE.—Canal gates closed June 12 to 20, and on June 26 for rest of the year.

Monthly discharge of Fort Belknap canal near Chinook, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
Mar. 19–31	.....	.....	32.8	845
April	.....	.....	63.0	3,750
May	81	67	68.8	4,240
June, 16 days	75	56	67.0	2,130

NOTE.—Discharge for period Mar. 19 to Apr. 30, estimated from statements of observer before regular observations began.

LITTLE PORCUPINE CREEK BASIN.

LITTLE PORCUPINE CREEK NEAR FRAZER, MONT.

Little Porcupine Creek rises near the central-western part of the Fort Peck Indian Reservation, flows southward, and enters Missouri River near Frazer, Mont.

The drainage area comprises a strip of land about 25 miles long, extending but a short distance back from the narrow valley bordering the stream. Except for a growth of cottonwoods and willows, the basin is without forestation.

The run-off comes from the melting snow in the spring and from heavy rains during the summer. During the greater part of the year the channel is dry, except for about one-half second-foot of water derived from springs near the mouth of the stream. The annual rainfall is about 13 inches. The stream is not used for diversion.

The only gaging station in this basin is about 2 miles south of Frazer, Mont. A staff gage is located on the stream near the house of the observer. Measurements are made by wading. The station was established July 13, 1908, to obtain data for use in connection with an irrigation project being constructed by the United States Reclamation Service for the Fort Peck Indians.

This station was discontinued September 30, 1910.

The following discharge measurement was made by Raymond Richards:

March 26, 1910: Width, 29 feet; area, 20 square feet; gage height, 2.43 feet; discharge, 51 second-feet.

Daily gage height, in feet, of Little Porcupine Creek near Frazer, Mont., for 1910.

[T. C. Flynn, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		2.4	1.4	1.25	1.25	1.2	1.35
2		2.25	1.45	1.2	1.2	1.25	1.3
3		2.2	1.4	1.25	1.25	1.2	1.35
4		2.25	1.35	1.25	1.25	1.25	1.35
5		2.25	1.35	1.2	1.2	1.25	1.3
6		2.0	1.3	1.25	1.25	1.2	1.35
7		2.05	1.35	1.2	1.2	1.25	1.3
8		1.9	1.3	1.25	1.25	1.2	1.35
9		1.95	1.35	1.35	1.25	1.25	1.35
10		2.05	1.35	1.3	1.2	1.25	1.3
11	2.55	2.1	1.3	1.35	1.25	1.2	1.35
12	3.0	2.15	1.35	1.3	1.2	1.35	1.3
13	4.05	2.0	1.3	1.35	1.25	1.3	1.35
14	4.0	2.25	1.35	1.35	1.25	1.35	1.35
15	3.05	2.25	1.35	2.65	1.2	1.35	1.3
16	4.05	2.1	1.3	2.05	1.25	1.3	1.35
17	3.5	2.05	1.35	1.7	1.3	1.35	1.3
18	3.05	1.9	1.2	1.35	1.35	1.3	1.35
19	2.9	1.75	1.25	1.35	1.35	1.35	1.35
20	2.95	1.75	1.25	1.35	1.2	1.35	1.3
21	2.95	1.6	1.2	1.35	1.25	1.2	1.35
22	2.5	1.65	1.25	1.3	1.2	1.25	1.3
23	2.55	1.5	1.2	1.35	1.25	1.2	1.35
24	2.9	1.55	1.25	1.35	1.25	1.25	1.35
25	2.95	1.45	1.35	1.25	1.2	1.25	1.3
26	3.05	1.4	1.3	1.25	1.25	1.2	1.35
27	2.4	1.45	1.35	1.2	1.3	1.25	1.3
28	3.55	1.5	1.3	1.25	1.25	1.2	1.35
29	3.6	1.55	1.35	1.25	1.25	1.35	1.35
30	3.25	1.45	1.35	1.2	1.2	1.35	1.3
31	3.05	.....	1.2	.....	1.25	1.3	.....

Daily discharge, in second-feet, of Little Porcupine Creek near Frazer, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		50	0	0			
2		40	1.5	0			
3		36	0	0			
4		40	0	0			
5		40	0	0			
6		25	0	0			
7		28	0	0			
8		20	0	0			
9		22	0	0			
10		28	0	0			

Daily discharge, in second-feet, of Little Porcupine Creek near Frazer, Mont., for 1910.—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
11	61	30	0	0			
12	97	33	0	0			
13	204	25	0	0			
14	198	40	0	0			
15	102	40	0	69			
16	204	30	0	28			
17	145	28	0	11			
18	102	20	0	0			
19	89	13	0				
20	93	13	0				
21	93	7	0				
22	57	9	0				
23	61	3	0				
24	89	5	0				
25	93	1.5	0				
26	102	0	0				
27	50	1.5	0				
28	150	3	0				
29	155	5	0				
30	120	1.5	0				
31	102		0				

NOTE.—These discharges are based on a rating curve that is fairly well defined.

Monthly discharge of Little Porcupine Creek near Frazer, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	204	0	[a] 83.8	5,150	C.
April	50	0	21.2	1,260	C.
May	1.5	0	.05	3	D.
June	69	0	3.60	214	D.

[a] Discharge estimated Mar. 1 to 10.

NOTE.—The creek was dry, or water standing pools, Jan. 1 to about Mar. 1, May 3 to June 14, and from June 18 to the end of the season. Total run-off in acre-feet for year, 6630.

WOLF CREEK BASIN.

WOLF CREEK NEAR WOLF POINT, MONT.

Wolf Creek rises near the center of the Fort Peck Indian reservation, flows southward, and enters Missouri River near the Wolf Point agency. The drainage area comprises the central part of the Fort Peck Indian reservation. The entire area, with the exception of a narrow valley along the stream, is a rolling prairie. The only forestation is the growth of willows and cottonwoods along the banks of the streams.

The run-off comes from the melting snow in the spring and heavy rains during the summer. The upper part of the channel is dry during the late summer and winter, but near the mouth the flow is kept up by springs. The annual rainfall is about 13 inches. The stream is not used for storage and the only diversion is that made

by the Indian agency ditch at Wolf Point, which takes the entire flow during the low period.

The gaging station, which was established August 15, 1908, to determine the amount of water available for an irrigation project under consideration by the United States Reclamation Service for the Fort Peck Indians, is located at William Smith's ranch, 2½ miles northwest of Wolf Point.

Measurements are made by wading near the staff gage, which is located close to the house of the observer.

The Wolf Point ditch heads above the gage and practically the entire low-water flow of the creek is diverted through it.

Discharge measurements of Wolf Creek near Wolf Point, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 27	Raymond Richards	20	38	3.51	80
May 10	M. E. McChristie	5	2	1.73	[a] 1.2

[a] Does not include flow in Wolf Point ditch.

Daily gage height, in feet, of Wolf Creek near Wolf Point, Mont., for 1910.

[W. H. Smith, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		2.8	1.85	1.95	1.9	1.45	1.45
2		2.8	1.9	1.95	1.85	1.45	1.45
3		2.8	1.85	1.95	1.55	1.45	1.45
4		2.8	1.9	2.0	1.55	1.45	1.5
5		2.6	1.85	1.85	1.55	1.5	1.45
6		2.6	1.85	1.85	1.6	1.45	1.45
7		2.6	1.85	1.85	1.55	1.45	1.45
8		2.7	1.95	1.85	1.55	1.45	1.45
9		2.7	2.0	1.85	1.55	1.45	1.5
10		2.7	1.95	1.9	1.5	1.5	1.45
11		2.65	2.0	1.85	1.6	1.45	1.45
12		2.5	1.95	1.85	1.55	1.45	1.45
13	3.9	2.5	1.95	1.85	1.55	1.45	1.45
14	3.9	2.5	1.95	1.85	1.55	1.45	1.5
15	3.9	2.45	1.85	1.9	1.5	1.5	1.45
16	3.6	2.5	1.9	1.85	1.6	1.45	1.45
17	3.6	2.35	1.85	1.85	1.45	1.45	1.45
18	3.2	2.4	1.85	1.85	1.45	1.45	1.45
19	3.2	2.3	1.85	1.85	1.45	1.45	1.5
20	3.2	2.25	1.95	1.9	1.45	1.5	1.45
21	3.1	2.1	2.0	1.85	1.5	1.45	1.45
22	3.1	2.05	1.85	1.85	1.45	1.45	1.45
23	3.1	2.1	1.85	1.85	1.45	1.45	1.45
24	2.5	2.05	1.85	1.85	1.45	1.45	1.5
25	2.5	2.05	1.85	1.85	1.45	1.5	1.45
26	2.75	2.2	1.9	1.9	1.5	1.45	1.45
27	3.05	2.15	1.85	1.85	1.45	1.45	1.45
28	2.8	2.1	1.85	1.85	1.45	1.45	1.45
29	2.7	2.05	1.95	1.85	1.45	1.45	1.5
30	2.7	2.05	1.95	1.85	1.45	1.5	1.45
31	2.7	.....	2.0	.....	1.5	1.45	.....

Daily discharge, in second-feet, of Wolf Creek near Wolf Point, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		29	2.3	3.2	2.7	0.1	0.1
2		29	2.7	3.2	2.3	.1	.1
3		29	2.3	3.2	.4	.1	.1
4		29	2.7	3.7	.4	.1	.2
5		18	2.3	2.3	.4	.2	.1
6		18	2.3	2.3	.6	.1	.1
7		18	2.3	2.3	.4	.1	.1
8		23	3.2	2.3	.4	.1	.1
9		23	3.7	2.3	.4	.1	.2
10		23	3.2	2.7	.2	.2	.1
11		21	3.7	2.3	.6	.1	.1
12		15	3.2	2.3	.4	.1	.1
13	110	15	3.2	2.3	.4	.1	.1
14	110	15	3.2	2.3	.4	.1	.2
15	110	13	2.3	2.7	.2	.2	.1
16	87	15	2.7	2.3	.6	.1	.1
17	87	10	2.3	2.3	.1	.1	.1
18	56	11	2.3	2.3	.1	.1	.1
19	56	8.8	2.3	2.3	.1	.1	.2
20	56	7.7	3.2	2.7	.1	.2	.1
21	49	5.0	3.7	2.3	.2	.1	.1
22	49	4.4	2.3	2.3	.1	.1	.1
23	49	5.0	2.3	2.3	.1	.1	.1
24	15	4.4	2.3	2.3	.1	.1	.2
25	15	4.4	2.3	2.3	.1	.2	.1
26	26	6.7	2.7	2.7	.2	.1	.1
27	45	5.8	2.3	2.3	.1	.1	.1
28	29	5.0	2.3	2.3	.1	.1	.1
29	23	4.4	3.2	2.3	.1	.1	.2
30	23	4.4	3.2	2.3	.1	.2	.1
31	23	.....	3.7	.....	.2	.1	.....

NOTE.—These discharges are based on a fairly well defined rating curve.

Monthly discharge of Wolf Creek near Wolf Point, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January			0	0	
February			0	0	
March			a 54.1	3,330	B.
April	29	4.4	14.0	833	B.
May	3.7	2.3	2.76	170	C.
June	3.7	2.3	2.49	148	C.
July	2.7	.1	.41	25	D.
August	.2	.1	.12	7	D.
September	.2	.1	.12	7	D.
October			0	0	
November			0	0	
December			0	0	
The year			6.17	4,520	

a Discharge estimated Mar. 1 to 12.

NOTE.—The creek was practically dry, or water standing in pools, Jan. 1 to about Mar. 1, and Oct. 1 to Dec. 31.

POPLAR CREEK BASIN.

POPLAR CREEK NEAR POPLAR, MONT.

Poplar Creek rises in the southern part of the Canadian Province of Saskatchewan, flows southeastward through the northern part of Valley County, Mont., thence through the Fort Peck Indian reservation, and unites with Missouri River near Poplar, Mont. The largest

tributary is the West Branch, which enters near the north boundary of the Fort Peck reservation. The greater part of the drainage area is a rolling prairie cut by a number of small coulees and the valley of the creek. The only forestation is a growth of willows and cottonwoods along the banks of the stream.

The run-off comes from melting snow in the spring and heavy rains during the summer. The dry-season flow is considerable. The annual rainfall at Poplar is about 13 inches.

The gaging station was established August 15, 1908, at Buershia's ranch, 6 miles north of Poplar, Mont.

A staff gage fastened to a tree is located on the right bank of the stream and across the creek from the house of the observer. The gage datum has not been changed. All measurements are made by wading.

Discharge measurements of Poplar Creek near Poplar, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 26	Raymond Richards	95	204	4.77	449
May 11	M. E. McChristie	63	56	2.93	70
July 1	do	20	24	2.53	18
28	do	30	21	2.34	6.1

NOTE.—Zero flow is at 2 feet.

Daily gage height, in feet, of Poplar Creek near Poplar, Mont., for 1910.

[Louis Obershaw, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	4.6	3.1	2.7	2.5	2.2	2.5	2.5	2.5
2	.....	4.4	3.1	2.7	2.5	2.2	2.5	2.5	2.5
3	.....	4.4	3.1	2.7	2.5	2.2	2.5	2.5	2.5
4	.....	4.3	3.1	2.7	2.5	2.2	2.5	2.5	2.5
5	.....	4.3	3.1	2.7	2.5	2.2	2.5	2.5	2.5
6	.....	4.3	3.1	2.6	2.5	2.2	2.5	2.5	2.5
7	.....	4.4	3.1	2.6	2.5	2.2	2.5	2.3	2.7
8	.....	4.5	3.0	2.6	2.5	2.2	2.5	2.3	2.6
9	.....	4.4	3.0	2.6	2.5	2.2	2.5	2.3	2.7
10	.....	4.3	3.0	2.6	2.5	2.2	2.5	2.3	2.7
11	.....	4.2	2.9	2.6	2.5	2.2	2.5	2.4	2.7
12	.....	4.1	2.8	2.6	2.5	2.2	2.5	2.4	2.6
13	.....	4.0	2.8	2.6	2.5	2.2	2.5	2.5	2.6
14	.....	3.9	2.8	2.7	2.5	2.2	2.5	2.5	2.7
15	.....	3.8	2.8	2.7	2.5	2.3	2.5	2.5	.....
16	.....	3.7	2.8	2.7	2.5	2.4	2.5	2.5	.....
17	.....	3.6	2.8	2.7	2.5	2.5	2.5	2.5	.....
18	.....	3.4	2.8	2.7	2.5	2.5	2.5	2.5	.....
19	.....	3.4	2.8	2.6	2.4	2.5	2.5	2.5	.....
20	.....	3.4	2.7	2.6	2.4	2.4	2.5	2.5	.....
21	.....	3.4	2.7	2.6	2.4	2.4	2.5	2.5	.....
22	.....	3.2	2.7	2.5	2.4	2.4	2.5	2.5	.....
23	.....	3.2	2.7	2.5	2.3	2.4	2.5	2.5	.....
24	.....	3.2	2.7	2.5	2.3	2.4	2.5	2.5	.....
25	.....	3.2	2.7	2.5	2.3	2.5	2.5	2.5	.....
26	4.8	3.2	2.7	2.5	2.3	2.5	2.5	2.5	.....
27	4.8	3.2	2.6	2.5	2.3	2.5	2.5	2.5	.....
28	5.0	3.2	2.6	2.5	2.3	2.5	2.5	2.5	.....
29	5.2	3.2	2.6	2.5	2.2	2.5	2.5	2.5	.....
30	5.1	3.2	2.7	2.5	2.2	2.5	2.5	2.5	.....
31	4.9	.....	2.7	.....	2.2	2.5	.....	2.5	.....

NOTE.—Ice probably existed during January and February, and after Nov. 14.

Daily discharge, in second-feet, of Poplar Creek near Poplar, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		418	94	36	15	2	15	15	15
2		360	94	36	15	2	15	15	15
3		360	94	36	15	2	15	15	15
4		336	94	36	15	2	15	15	15
5		336	94	36	15	2	15	15	15
6		336	94	29	15	2	15	15	15
7		360	94	29	15	2	15	5	30
8		384	79	28	15	2	15	5	22
9		360	79	27	15	2	15	5	30
10		336	79	27	15	2	15	5	30
11		312	66	26	15	2	15	9.5	30
12		289	52	25	15	2	15	9.5	22
13		267	52	25	15	2	15	15	22
14		245	52	34	15	2	15	15	30
15		223	52	34	15	5	15	15	.....
16		202	52	34	15	9.5	15	15	.....
17		182	51	33	15	15	15	15	.....
18		145	51	33	15	15	15	15	.....
19		145	51	25	9.5	15	15	15	.....
20		145	39	24	9.5	9.5	15	15	.....
21		145	39	24	9.5	9.5	15	15	.....
22		110	39	17	9.5	9.5	15	15	.....
23		110	39	17	5	9.5	15	15	.....
24		110	38	17	5	9.5	15	15	.....
25		110	38	16	5	15	15	15	.....
26	457	110	38	16	5	15	15	15	.....
27	457	110	28	16	5	15	15	15	.....
28	507	110	28	15	5	15	15	15	.....
29	557	110	28	15	2	15	15	15	.....
30	532	110	37	15	2	15	15	15	.....
31	482	.....	37	.....	2	15	.....	15	.....

NOTE.—These discharges are based on rating curves applicable as follows: Mar. 26 to May 11, poorly defined; May 12 to June 30, indirect method for shifting channels; July 1 to Nov. 14, well defined. This is the same as the 1909 curves.

Monthly discharge of Poplar Creek near Poplar, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January			[a] 15.0	922	
February			[a] 15.0	833	
March			[a] 600	36,900	
April	418	110	229	13,600	B.
May	94	28	58.1	3,570	B.
June	36	15	26.0	1,550	C.
July	15	2	11.1	682	B.
August	15	2	7.74	476	B.
September	15	15	15.0	893	C.
October	15	9.5	13.4	824	C.
November			[b] 18.7	1,110	
December			[a] 15.0	922	
The year			85.3	62,300	

[a] Discharge estimated by comparison with Big Muddy River near Culbertson.
[b] Nov. 15 to 30 estimated because of ice.

NOTE.—Means for January, February, March, and December are only approximate.

BIG MUDDY RIVER BASIN.

BIG MUDDY RIVER NEAR CULBERTSON, MONT.

Big Muddy River rises in the Province of Saskatchewan, Canada, flows southward into Montana, forms the eastern boundary of the Fort Peck Indian reservation, and unites with Missouri River near Blair, Mont. It drains a rolling prairie cut by many small coulees. The greater part of the run-off comes from the melting snow in the spring months.

The gaging station, which was established July 14, 1908, to determine the amount of water available for irrigation projects under consideration by the United States Reclamation Service for the Fort Peck Indians, is located about 3 miles above the mouth of the stream.

Because of backwater from the Missouri River, this station was discontinued July 19, 1909, and a new station was established at Gustave Sholtz's ranch, 8 miles above.

The results obtained at the new station are considered good.

The gage is of the inclined-rod type and is located on the left bank of the stream, near the residence of the observer. The gage datum has remained the same. All measurements are made by wading.

The following discharge measurement was made by R. Richards:

March 25, 1910: Width, 71 feet; area, 182 square feet; gage height, 4.76 feet; discharge, 156 second-feet.

Daily gage height, in feet, of Big Muddy River near Culbertson, Mont., for 1910.

[Gustave Sholtz, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	4.5	2.65	2.4	2.75	1.7	1.75
2	.....	4.5	2.6	2.4	2.6	1.75	1.7
3	.....	4.5	2.5	2.45	2.65	1.7	1.7
4	.....	4.5	2.55	2.3	2.5	1.7	1.75
5	.....	4.15	2.5	2.3	2.5	1.75	1.7
6	7.1	4.2	2.55	2.45	2.45	1.7	1.75
7	7.1	3.8	2.4	2.4	2.4	1.75	1.7
8	7.05	3.8	2.4	2.45	2.45	1.7	1.7
9	7.1	3.8	2.45	2.4	2.4	1.7	1.75
10	7.2	3.75	2.4	2.5	2.3	1.75	1.7
11	7.2	3.8	2.45	2.55	2.35	1.7	1.7
12	7.25	3.8	2.4	3.5	2.3	1.75	1.75
13	7.3	3.7	2.4	3.75	2.35	1.7	1.7
14	7.3	3.7	2.45	3.5	2.3	1.7	1.75
15	7.15	3.65	2.4	3.2	2.3	1.75	1.6
16	7.1	3.7	2.45	3.05	2.25	1.7	1.6
17	7.1	3.2	2.4	2.7	2.1	1.75	1.65
18	6.95	3.2	2.4	2.75	2.15	1.7	1.6
19	7.0	3.25	2.45	2.7	2.1	1.7	1.65
20	6.8	3.1	2.5	2.7	2.1	1.75	1.6
21	6.8	2.85	2.45	2.75	2.05	1.7	1.6
22	6.45	2.8	2.4	2.7	2.0	1.75	1.65
23	6.5	2.8	2.3	2.75	1.95	1.7	1.6
24	6.2	2.85	2.35	2.7	1.9	1.7	1.65
25	5.45	2.8	2.3	2.7	1.8	1.75	1.6
26	4.8	2.75	2.35	2.75	1.85	1.7	1.6
27	4.6	2.7	2.4	2.7	1.8	1.75	1.65
28	4.6	2.7	2.4	2.75	1.85	1.7	1.6
29	4.5	2.75	2.55	2.7	1.8	1.7	1.65
30	4.4	2.7	2.6	2.8	1.7	1.75	1.7
31	4.4	.....	2.55	.....	1.75	1.7	.....

Daily discharge, in second-feet, of Big Muddy River near Culbertson, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	129	5.8	3.2	7.3	0.5	0.6
2	.....	129	5.2	3.2	5.2	.6	.5
3	.....	129	4.1	3.6	5.8	.5	.5
4	.....	129	4.6	2.5	4.1	.5	.6
5	.....	92	4.1	2.5	4.1	.6	.5
6	436	97	4.6	3.6	3.6	.5	.6
7	436	59	3.2	3.2	3.2	.6	.5
8	430	59	3.2	3.6	3.6	.5	.5
9	436	59	3.6	3.2	3.2	.5	.6
10	448	55	3.2	4.1	2.5	.6	.5
11	448	59	3.6	4.6	2.8	.5	.5
12	454	59	3.2	36	2.5	.6	.6
13	460	51	3.2	55	2.8	.5	.5
14	460	51	3.6	36	2.5	.5	.6
15	442	47	3.2	19	2.5	.6	.3
16	436	51	3.6	14	2.2	.5	.3
17	436	19	3.2	6.5	1.6	.6	.4
18	418	19	3.2	7.3	1.8	.5	.3
19	424	21	3.6	6.5	1.6	.5	.4
20	400	15	4.1	6.5	1.6	.6	.3
21	400	9.1	3.6	7.3	1.4	.5	.3
22	358	8.1	3.2	6.5	1.3	.6	.4
23	364	8.1	2.5	7.3	1.2	.5	.3
24	328	9.1	2.8	6.5	1.0	.5	.4
25	238	8.1	2.5	6.5	.7	.6	.3
26	162	7.3	2.8	7.3	.8	.5	.3
27	140	6.5	3.2	6.5	.7	.6	.4
28	140	6.5	3.2	7.3	.8	.5	.3
29	129	7.3	4.6	6.5	.7	.5	.4
30	118	6.5	5.2	8.1	.5	.6	.5
31	118	.....	4.6	.....	.6	.5	.....

NOTE.—These discharges are based on a rating curve fairly well defined below 160 second-feet. Below 8.1 second-feet the 1909 rating was used.

Monthly discharge of Big Muddy River near Culbertson, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	0	0	
February	.....	.....	0	0	
March	460	.....	[a] 326	20,000	C.
April	129	6.5	46.9	2,790	B.
May	5.8	2.5	3.69	227	C.
June	55	2.5	9.80	583	C.
July	7.3	.5	2.39	147	C.
August	.6	.5	.54	33	C.
September	.6	.3	.44	26	C.
October	.....	.....	0	0	
November	.....	.....	0	0	
December	.....	.....	0	0	
The year	.....	.....	32.5	23,800	

[a] Discharge estimated Mar. 1 to 5.

NOTE.—There was little or no flow during months of January, February, October, November, and December.

YELLOWSTONE RIVER BASIN.

DESCRIPTION.

The upper Yellowstone rises in the Shoshone Mountains, in northwestern Wyoming, near the southeast corner of the Yellowstone National Park, flows northwestward for 40 or 50 miles, and then enters Yellowstone Lake, which may be considered the great source of the main river. This lake is about 15 miles long by 20 miles wide, lies at an elevation of 7,778 feet above the sea, and is hemmed in on every side by lofty mountains, from whose snow-covered slopes its chief supply of water must come, since it receives no important streams. Issuing from the lake at the north end, the river flows northwestward for 10 to 15 miles, plunges over the Great Falls of the Yellowstone, and for the next 20 miles runs through its "Grand Canyon," which is impassable throughout. About 80 miles from the lake it emerges from the Snow Mountains, and thence runs eastward and northeastward until it joins the Missouri at Fort Buford, N. Dak. At this point it has an elevation of about 1,900 feet.

As it leaves the mountains the river is about 600 feet wide; thence to Clark Fork, which enters from the south about 15 miles above Billings, Mont., it is characterized by bold, sweeping curves and many islands. Between Clark Fork and the mouth of the Bighorn it is from 1,500 to 1,800 feet wide, is free from rapids, and has a current from 3 to 4 miles an hour. Between the Bighorn and the Powder the main stream increases in width from 2,400 to 2,700 feet and becomes turbid, like the Missouri. Below the mouth of the Powder the banks are low and caving, and the stream contains some rapids and shoals and numerous densely timbered islands.

The Yellowstone is about 500 miles long; the area of its basin is approximately 67,500 square miles.

Of the tributaries of the Yellowstone the most important is the Bighorn,[1] which has its source in the many small streams draining the slopes of the Wind River Range. Other important tributaries of the Yellowstone are the Shields, Boulder, Big Timber, Sweetgrass, Stillwater, Clark Fork, Tongue, and Powder rivers. Shields, Big Timber, and Sweetgrass rivers have their sources in the Crazy Mountains, rising to an elevation of 10,000 feet; the Boulder, Stillwater, and Clark Fork rise on the southeastern slope of the Shoshone Mountains, at an elevation of 10,500 feet. Powder and Tongue rivers have their source in the high plains region and Bighorn Mountains of Wyoming, flowing parallel and in a northeasterly direction until they join the Yellowstone.

[1] See description of Bighorn basin on pp. 173–175.

The headwaters of the Yellowstone and many of its tributaries drain portions of heavily timbered areas. The Yellowstone, Crazy Mountain, Bighorn, and Otter national forests are thus drained. However, the greater part of the drainage basin lies within the plains section and is treeless except for a few willows and cottonwoods along the stream channels.

The mean annual rainfall in Yellowstone Park is approximately 17 inches; at Billings, 15 inches; Glendive, 10 inches; and at Buford, 12¼ inches. A greater portion of the rainfall occurs in June. Snow lies in the mountains from November to June. The streams are partly frozen during the colder months.

The great areas of irrigable land and the abundant water supply afford wonderful opportunities for irrigation in the Yellowstone basin. The United States Reclamation Service has practically completed irrigation projects diverting water from the Yellowstone and reclaiming 100,000 acres of arid land. The Shoshone project, reclaiming 132,000 acres, is partly finished. Several private irrigation projects are completed and more are under construction.

Many possible reservoir sites for the storage of flood water are found on the upper portion of the Yellowstone and its tributaries. Shoshone dam, 325 feet high, on the Shoshone River, stores 456,000 acre-feet.

The Yellowstone basin contains many natural power sites. The abundance of water and the magnitude of fall in the higher altitudes make the development of hydroelectric power most feasible. Power for municipal purposes is now generated at Livingston, Big Timber, and Billings.

The run-off record extends back to 1889, although a few stream measurements were made on the Yellowstone River in the national park as early as 1878. The wettest year recorded at Livingston from 1897 to 1908 was 1899; the driest was 1905.

YELLOWSTONE RIVER AT CORWIN SPRINGS, MONT.

This station was established September 2, 1910, in the canyon at Corwin Springs, Mont., 8 miles below Gardiner, one of the entrances to Yellowstone National Park. Gardiner River is the most important tributary between the station and Yellowstone Lake.

A staff gage is nailed to the right-bank wooden pier on lower side of highway bridge. Discharge measurements are made from the downstream side of highway bridge.

The bed of the stream is rocky and free from vegetation.

Practically no water is diverted from the Yellowstone near this station.

Sufficient measurements have not been made to develop a rating curve.

The following discharge measurement was made by Raymond Richards:

September 2, 1910: Width, 238 feet; area, 585 square feet; gage height, 1.80 feet; discharge, 1,710 second-feet.

Daily gage height, in feet, of Yellowstone River at Corwin Springs, Mont., for 1910.

[C. H. Wilks, observer.]

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		1.4	1.2	1.1	16	1.6	1.4	1.0	
2	1.8	1.4	1.2	1.1	17	1.6	1.4	1.1	
3	1.7	1.4	1.2	1.1	18	1.6	1.4	1.1	
4	1.7	1.5	1.2	1.1	19	1.5	1.4	1.1	
5	1.7	1.5	1.1	1.0	20	1.5	1.3	1.0	
6	1.7	1.5	1.1	1.1	21	1.5	1.3	1.1	
7	1.7	1.4	1.1	1.0	22	1.6	1.3	1.1	
8	1.7	1.4	1.1	1.0	23	1.6	1.3	1.1	
9	1.6	1.4	1.2	1.0	24	1.5	1.3	1.1	
10	1.5	1.4	1.2	1.0	25	1.5	1.3	1.1	
11	1.6	1.4	1.2	1.0	26	1.5	1.3	1.2	
12	1.6	1.4	1.1	1.0	27	1.5	1.2	1.0	
13	1.6	1.5	1.2		28	1.5	1.2	1.0	
14	1.6	1.4	1.1		29	1.5	1.2	1.1	
15	1.6	1.4	1.0		30	1.4	1.2	1.1	
					31		1.2		

NOTE.—Ice Dec. 13 to 31.

YELLOWSTONE RIVER AT HUNTLEY, MONT.

This station, which is located at the new steel highway bridge 1 mile below Huntley, Mont., and replaces that formerly maintained at Junction, was established October 1, 1907, to obtain data applicable to irrigation and power development.

The only tributary near the station is Pryor Creek, which enters the Yellowstone 1 mile above. The drainage area at Huntley is about 12,000 square miles.

The Huntley canal, built by the United States Reclamation Service, takes water from the river about 2 miles above the gaging station; its normal capacity is 400 second-feet, and it supplies water for 29,000 acres of land. Near Laurel are the head gates of the Billings Land & Irrigation Co.'s large canal, which carries about 305 second-feet and irrigates 28,000 acres. Many small ditches take water from the tributaries of the Yellowstone, but few from the stream itself, owing to the variation of the stages of the water surface and consequent difficulty in diversion.

This river freezes entirely over in places during the winter, but during the coldest seasons open channels with floating ice are not uncommonly seen. Conditions for obtaining accurate data at this station are only fair, as the channel is shifting and extra measurements are necessary to obtain a good rating curve.

Measurements are made from the downstream side of the bridge. The chain gage used at this station is fastened to the bridge rail. The gage datum has remained unchanged.

Discharge measurements of Yellowstone River at Huntley, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 10	W. A. Lamb	230	2,510	5.68	18,400
June 3	Raymond Richards	535	4,680	8.08	30,600
July 18	....do	234	1,860	3.78	7,970
26	J. C. Beebe	240	1,820	3.62	8,030
Aug. 10	W. A. Lamb	216	1,590	2.82	4,090
24	....do	200	1,540	2.50	3,300
Nov. 13	....do	207	1,540	2.52	3,310

Daily gage height, in feet, of Yellowstone River at Huntley, Mont., for 1910.

[Arthur Foster, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.50	5.70	7.75	5.10	.....	2.45	2.75	2.50	2.35
2	.....	2.50	5.70	8.40	5.10	.....	2.40	2.70	2.50	2.42
3	.....	2.50	5.40	8.10	4.90	.....	2.40	2.70	2.50	2.45
4	.....	2.50	5.30	7.00	4.80	.....	2.40	2.70	2.50	2.50
5	.....	2.50	5.10	6.40	4.60	.....	2.40	2.70	2.50	2.52
6	.....	2.50	5.10	6.10	4.60	.....	2.40	2.70	2.50	2.52
7	.....	2.50	5.00	6.10	4.50	.....	2.40	2.70	2.50	2.55
8	.....	2.40	5.10	6.00	4.30	.....	2.40	2.70	2.50	2.55
9	.....	2.40	5.50	6.00	4.20	.....	2.40	2.70	2.50	2.55
10	.....	2.50	5.70	5.90	4.10	2.85	2.40	2.75	2.52	2.57
11	5.20	2.60	6.70	6.00	4.00	2.85	2.40	2.70	2.50	2.50
12	5.00	2.60	6.50	6.10	4.00	2.65	2.60	2.70	2.50	2.45
13	3.50	3.00	6.30	6.10	4.00	2.75	2.50	2.60	2.50	2.38
14	3.00	3.05	6.20	6.10	3.90	2.40	2.50	2.60	2.47	2.35
15	2.60	3.10	6.20	6.20	3.80	2.90	2.50	2.60	2.47	2.35
16	2.50	3.10	6.00	6.20	3.80	2.80	2.40	2.60	2.45	2.35
17	2.60	3.10	5.70	6.30	3.80	2.75	2.40	2.75	2.45	2.35
18	2.60	3.30	5.40	6.50	3.90	2.70	2.40	2.75	2.45	2.35
19	2.60	3.30	5.20	6.40	3.90	2.70	2.40	2.75	2.55	2.35
20	2.60	3.40	5.00	6.40	3.90	2.60	2.40	2.65	2.47	2.35
21	2.65	3.50	5.00	6.20	3.80	2.60	2.60	2.65	2.47	2.35
22	2.70	3.50	4.90	6.20	3.80	2.50	2.70	2.60	2.48	2.35
23	2.90	3.60	5.00	6.00	4.40	2.50	3.00	2.60	2.48	2.35
24	2.90	3.80	5.40	5.70	4.50	2.50	3.00	2.60	2.48	2.35
25	2.90	4.00	6.00	5.40	4.00	2.50	3.10	2.65	2.48	2.35
26	2.80	4.30	6.80	5.20	3.60	2.45	3.15	2.65	2.48	2.32
27	2.80	4.60	6.80	5.20	3.50	2.45	3.00	2.65	2.45	2.32
28	2.70	4.90	6.90	5.20	3.40	2.45	2.90	2.60	2.40	2.32
29	2.60	5.40	6.60	5.10	3.35	2.45	2.90	2.60	2.35	2.30
30	2.60	5.90	6.50	5.10	3.30	2.45	2.85	2.55	2.35	2.30
31	2.60	.....	6.80	.....	3.20	2.45	.....	2.55	.....	2.28

NOTE.—Ice January and February. Water away from gage Aug. 1 to 9.

Daily discharge, in second-feet, of Yellowstone River at Huntley, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		5,010	18,500	29,000	14,000	5,520	3,080	4,050	3,240	2,760
2		5,010	18,500	31,600	14,000	5,390	2,920	3,880	3,240	2,980
3		5,010	17,000	30,600	13,000	5,270	2,920	3,880	3,240	3,080
4		5,010	16,500	24,300	12,500	5,140	2,920	3,880	3,240	3,240
5		5,010	15,400	20,900	11,600	5,020	2,920	3,880	3,240	3,300
6		5,010	15,400	19,200	11,600	4,890	2,920	3,880	3,240	3,300
7		5,010	15,000	19,200	11,200	4,760	2,920	3,880	3,240	3,400
8		4,730	15,400	18,700	10,300	4,630	2,920	3,880	3,240	3,400
9		4,730	17,500	18,700	9,840	4,500	2,920	3,880	3,240	3,400
10		5,010	18,500	18,200	9,400	4,390	2,920	4,050	3,300	3,460
11	16,000	5,300	23,900	18,700	8,960	4,390	2,920	3,880	3,240	3,240
12	15,000	5,300	22,600	19,200	8,960	3,720	3,500	3,880	3,240	3,080
13	8,230	6,520	21,600	19,200	8,960	4,050	3,240	3,560	3,240	2,860
14	6,520	6,680	21,000	19,200	8,520	2,920	3,240	3,560	3,140	2,760
15	5,300	6,840	20,900	19,800	8,080	4,560	3,240	3,560	3,140	2,760
16	5,010	6,840	20,000	19,800	8,080	4,220	2,920	3,560	3,080	2,760
17	5,300	6,840	18,400	20,300	8,080	4,050	2,920	4,050	3,080	2,760
18	5,300	7,500	17,000	21,400	8,520	3,880	2,920	4,050	3,080	2,760
19	5,300	7,500	15,900	20,900	8,520	3,880	2,920	4,050	3,400	2,760
20	5,300	7,860	15,200	20,900	8,520	3,560	2,920	3,720	3,140	2,760
21	5,450	8,230	15,200	19,800	8,080	3,560	3,560	3,720	3,140	2,760
22	5,600	8,230	15,000	19,800	8,080	3,240	3,880	3,560	3,180	2,760
23	6,200	8,610	15,600	18,700	10,700	3,240	4,910	3,560	3,180	2,760
24	6,200	9,400	17,200	17,100	11,200	3,240	4,910	3,560	3,180	2,760
25	6,200	10,200	19,900	15,500	8,960	3,240	5,270	3,720	3,180	2,760
26	5,900	11,600	24,000	14,500	7,220	3,080	5,460	3,720	3,180	2,670
27	5,900	13,000	24,000	14,500	6,810	3,080	4,910	3,720	3,080	2,670
28	5,600	14,500	24,600	14,500	6,410	3,080	4,560	3,560	2,920	2,670
29	5,300	17,000	23,200	14,000	6,220	3,080	4,560	3,560	2,760	2,600
30	5,300	19,600	22,800	14,000	6,020	3,080	4,390	3,400	2,760	2,600
31	5,300	.....	26,600	.....	5,640	3,080	.....	3,400	.....	2,540

NOTE.—These discharges are based on rating curves applicable as follows: Mar. 11 to May 10, fairly well defined; May 11 to June 3, indirect method for shifting channels used; June 4 to Dec. 31, fairly well defined. Discharges Aug. 1 to 9 interpolated.

Monthly discharge of Yellowstone River at Huntley, Mont., for 1910.

[Drainage area 12,000 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	[a] 3,000	0.250	0.29	184,000	
February	.....	.....	[a] 2,900	.242	.25	161,000	
March	.....	.....	[a] 8,330	.693	.80	512,000	B.
April	19,600	4,730	7,640	.637	.71	455,000	B.
May	26,600	15,000	19,100	1.59	1.83	1,170,000	B.
June	31,600	14,000	19,700	1.64	1.83	1,170,000	B.
July	14,000	5,640	9,290	.774	.89	571,000	B.
August	5,520	3,080	3,980	.332	.38	245,000	B.
September	5,460	2,920	3,550	.296	.33	211,000	B.
October	4,050	3,400	3,870	.322	.37	238,000	B.
November	3,300	2,760	3,160	.263	.29	188,000	B.
December	3,460	2,540	2,920	.243	.28	180,000	C.
The year	26,600	2,540	7,280	.607	8.25	5,280,000	

[a] Discharge estimated Jan. 1 to Mar. 10.

NOTE.—The means for January and February are only approximate.

YELLOWSTONE RIVER AT GLENDIVE, MONT.

This station, which was established in 1893 by the United States War Department, was transferred to the Department of Agriculture, which has kept daily records of river height. When a study of the lower Yellowstone Valley was begun in 1903 the station was taken up by the United States Geological Survey, whose records began August 1, 1903. The station is located at the steel highway bridge leading northward from Glendive, about one-fourth mile from the post office. The records are used to determine the amount of water available for the lower Yellowstone project and other irrigation enterprises. The drainage area of Yellowstone River at Glendive is 66,100 square miles.

The only large diversion from the Yellowstone near Glendive is the lower Yellowstone canal, built by the United States Reclamation Service. It leaves the river 18 miles below Glendive and diverts water to irrigate 66,000 acres of land.

A standard chain gage fastened to a bridge rail is used, and since 1903 no change in gage datum has been made. All measurements are made from the bridge. The records obtained at this station are good during the open season, although in low water the old piling and cribwork of a former bridge somewhat obstruct the flow. Ice usually exists from December to April.

Discharge measurements of Yellowstone River at Glendive, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 11	W. A. Lamb	857	6,230	6.56	33,500
Aug. 11	do	724	3,100	2.58	8,840

Daily gage height, in feet, of Yellowstone River at Glendive, Mont., for 1910.

[E. C. Andrews, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.3	5.9	6.65	5.3	3.1	1.4	2.6	1.3	1.5
2	4.7	2.15	6.1	6.9	5.25	3.05	1.4	2.2	1.3	3.5
3	5.7	2.1	5.95	7.4	5.1	3.0	1.35	1.75	1.3	3.6
4		2.0	5.55	7.55	5.0	2.95	1.3	1.6	1.3	3.6
5		2.0	5.2	7.85	4.95	2.85	1.3	1.5	1.3	3.6
6		2.0	4.95	7.4	4.85	2.8	1.3	1.5	1.3	3.7
7		1.95	4.65	7.1	4.8	2.7	1.3	1.4	1.3	3.7
8	7.85	1.9	5.05	7.05	4.7	2.7	1.3	1.4	1.3	3.9
9	7.35	1.8	5.45	7.85	4.55	2.6	1.2	1.4	1.3	3.9
10	6.35	1.8	5.05	7.0	4.45	2.6	1.2	1.4	1.3	3.9
11	5.9	1.8	5.2	6.5	4.25	2.6	1.3	1.3	1.3	3.9
12	5.5	1.8	5.35	5.95	3.95	2.5	1.3	1.3	1.3	3.9
13	5.3	1.85	5.8	5.65	3.8	2.5	1.3	1.3	1.3	4.0
14	4.85	2.15	6.8	5.9	3.7	2.4	1.3	1.3	1.3	4.0
15	4.15	2.6	6.8	5.75	3.6	2.4	1.4	1.2	1.2	4.1

Daily gage height, in feet, of Yellowstone River at Glendive, Mont., for 1910—Contd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	4.0	2.75	6.85	5.85	3.5	2.4	1.4	1.2	1.2	4.2
17	3.6	2.95	7.0	5.85	3.4	2.25	1.3	1.2	1.2	4.2
18	3.35	3.0	6.95	5.8	3.35	2.15	1.3	1.2	1.2	4.2
19	3.1	2.9	6.55	6.05	3.3	2.0	1.3	1.3	1.3	4.2
20	2.95	2.75	6.1	6.15	3.3	2.0	1.3	1.3	1.3	4.2
21	2.8	2.6	5.95	6.4	3.35	1.9	1.3	1.3	1.3	4.2
22	2.7	2.65	5.65	6.3	3.4	1.8	1.45	1.3	1.3	4.2
23	2.7	2.9	5.6	6.15	3.75	1.7	1.8	1.3	1.3	4.2
24	2.8	3.5	5.6	6.0	4.1	1.6	2.25	1.3	1.3	4.2
25	2.85	3.65	5.4	5.8	4.25	1.6	2.7	1.3	1.3	4.2
26	2.95	3.6	5.35	5.75	4.05	1.6	3.6	1.3	1.3	4.2
27	3.3	3.75	5.8	5.75	3.8	1.5	4.15	1.3	1.3	4.2
28	2.95	4.15	6.6	5.6	3.4	1.5	4.05	1.3	1.3	4.2
29	.....	4.65	6.9	5.5	3.2	1.5	3.9	1.3	1.3	4.2
30	2.5	5.15	7.0	5.3	3.2	1.5	3.3	1.3	1.3	4.2
31	2.4	.....	7.1	.....	3.1	1.5	.....	1.3	.....	4.2

NOTE.—River frozen January, February, Mar. 1 to 4. Ice breaking up Mar. 4. River clear Mar. 8. River frozen again Dec. 2.

Daily discharge, in second-feet, of Yellowstone River at Glendive, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	8,160	27,700	34,500	23,100	10,900	5,760	9,120	5,540
2	.....	7,720	29,400	37,000	22,700	10,700	5,760	7,860	5,540
3	.....	7,570	28,200	42,400	21,700	10,500	5,650	6,610	5,540
4	.....	7,290	24,900	44,000	21,100	10,400	5,540	6,230	5,540
5	.....	7,290	22,400	47,600	20,700	9,990	5,540	5,990	5,540
6	.....	7,290	20,700	42,400	20,100	9,810	5,540	5,990	5,540
7	.....	7,150	18,800	39,100	19,800	9,460	5,540	5,760	5,540
8	47,600	7,010	21,400	38,600	19,200	9,460	5,540	5,760	5,540
9	41,800	6,740	24,200	47,600	18,200	9,120	5,330	5,760	5,540
10	31,700	6,740	21,400	38,000	17,600	9,120	5,330	5,760	5,540
11	27,700	6,740	22,400	33,000	16,500	9,120	5,540	5,540	5,540
12	24,600	6,740	23,400	28,200	14,900	8,790	5,540	5,540	5,540
13	23,100	6,880	26,900	25,700	14,100	8,790	5,540	5,540	5,540
14	20,100	7,720	36,000	27,700	13,600	8,470	5,540	5,540	5,540
15	15,900	9,120	36,000	26,500	13,100	8,470	5,760	5,330	5,330
16	15,100	9,640	36,400	27,300	12,600	8,470	5,760	5,330	5,330
17	13,100	10,400	38,000	27,300	12,200	8,010	5,540	5,330	5,330
18	12,000	10,500	37,500	26,900	12,000	7,720	5,540	5,330	5,330
19	10,900	10,200	33,500	29,000	11,700	7,290	5,540	5,540	5,540
20	10,400	9,640	29,400	29,900	11,700	7,290	5,540	5,540	5,540
21	9,810	9,120	28,200	32,100	12,000	7,010	5,540	5,540	5,540
22	9,460	9,290	25,700	31,200	12,200	6,740	5,880	5,540	5,540
23	9,460	10,200	25,300	29,900	13,800	6,480	6,740	5,540	5,540
24	9,810	12,600	25,300	28,600	15,600	6,230	8,010	5,540	5,540
25	9,990	13,400	23,800	26,900	16,500	6,230	9,460	5,540	5,540
26	10,400	13,100	23,400	26,500	15,400	6,230	13,100	5,540	5,540
27	11,700	13,800	26,900	26,500	14,100	5,990	15,900	5,540	5,540
28	10,400	15,900	34,000	25,300	12,200	5,990	15,400	5,540	5,540
29	[a] 9,600	18,800	37,000	24,600	11,300	5,990	14,600	5,540	5,540
30	8,790	22,100	38,000	23,100	11,300	5,990	11,700	5,540	5,540
31	8,470	.....	39,100	.....	10,900	5,990	.....	5,540	.....

[a] Interpolated.

NOTE.—These discharges are based on a rating curve that is well defined. All measurements made at this station were considered in developing the rating curve.

Monthly discharge of Yellowstone River at Glendive, Mont., for 1910.

[Drainage area, 66,100 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January			[a] 5,500	0.083	0.01	338,000	
February			[a] 5,000	.076	.08	278,000	
March			[a] 18,800	.284	.33	1,160,000	C.
April	22,100	6,740	9,960	.151	.17	593,000	A.
May	39,100	18,800	28,600	.433	.50	1,760,000	A.
June	47,600	23,100	32,200	.487	.54	1,920,000	A.
July	23,100	10,900	15,500	.234	.27	953,000	A.
August	10,900	5,990	8,090	.122	.14	497,000	A.
September	15,900	5,330	7,260	.110	.12	432,000	A.
October	9,120	5,330	5,820	.088	.10	358,000	B.
November	5,540	5,330	5,510	.083	.09	328,000	B.
December			[a] 4,500	.068	.08	277,000	
The year			12,300	.186	2.52	8,890,000	

[a] Discharge estimated Jan. 1 to Mar. 7 and Dec. 1 to 31.

NOTE.—The means for January, February, and December are only approximate.

BIG TIMBER CREEK BASIN.

NORTH FORK OF BIG TIMBER CREEK NEAR BIG TIMBER, MONT.

This station, which was established May 6, 1907, is located 1 mile above the Tintinger ranch, 15 miles northwest of Big Timber, just above the junction with the South Fork.

The source of North Fork is two lakes in the Crazy Mountains. These lakes form excellent reservoir sites. It is proposed to utilize the flow of the North Fork in connection with a project under the Carey Act. The drainage area above the station is only 40 square miles.

Several ditches above the station divert water to irrigate approximately 300 acres of land. A large ditch appropriating 50,000 inches of water has its head gate just below the gage. This appropriation includes both forks. The water rights on Big Timber Creek have never been adjudicated.

A staff gage is located on the left bank of the stream. Its datum has remained constant. Measurements are made by wading.

At the gaging station the bed of the stream is composed of bowlders and coarse gravel, and is probably permanent. Results obtained during the open season are good.

Discharge measurements of North Fork of Big Timber Creek near Big Timber, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 8	W. A. Lamb	17	12	1.03	22
May 8	Raymond Richards	38	37	1.84	98
June 8	do	35	30	1.58	67
July 9	do	19	14	.99	19
Aug. 18	C. S. Heidel	17	8.9	.73	7.7
Oct. 5	do	18	13	.97	17
Dec. 14[a]	do	18	14	1.02	16

[a] Ice.

NOTE.—All measurements made by wading near gage.

Daily gage height, in feet, of North Fork of Big Timber Creek near Big Timber, Mont., for 1910.

[N. J. Tintinger, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1		1.18	1.63		0.75	0.90	1.00	0.95
2		1.18	1.63		.75	.90	1.00	1.00
3		1.23	1.73		.75	1.10	.90	.95
4		1.18	1.88		.80	1.10	.90	1.00
5		1.08	1.78		.75	.95	.80	.97
6		1.08	1.93		.75	1.00	.70	
7		1.03	1.93		.75	1.00	.75	
8	0.93	1.03	1.98	1.20	.75	1.00	.75	
9	.98	1.03	2.00	1.20	1.00	1.10	.75	
10	.98	1.13	2.00	1.30	.95	.95	.65	
11	1.08	1.13	2.00	1.30	.95	1.00	.75	
12	.98	1.23		1.30	.80	1.00	.80	
13	1.03	1.23		1.30	.75	1.20	.70	
14	1.03	1.33		1.25	.75	1.10	1.20	
15	1.08	1.33		1.30	1.05	.95	1.20	
16	1.08	1.43		1.30	1.10	1.00	1.15	
17	1.08	1.53		1.25	1.00	.85	1.25	
18	1.13	1.53		1.20	1.00	.73	1.25	
19	1.13	1.53		1.20	1.00	.85	1.25	
20	1.13	1.53		1.20	.95	.75	1.20	
21	1.08	1.53		1.00	1.00	.85	1.20	
22	1.23	1.53		1.00	1.00	.85	1.15	
23	1.23	1.53		1.00	.95	.85	1.05	
24	1.18	1.53		.90	.95	1.10	1.20	
25	1.18	1.63		.80	.90	1.00	1.25	
26	1.13	1.63		.80	.95	1.10		
27	1.08	1.68		.80	.95	1.00		
28	1.08	1.93		.75	.95	.80		
29	1.08	1.93		.75	.95	.80		
30	1.08	1.88		.75	.85	.75		
31	1.13				.90	.90		

NOTE.—Ice probably existed January, February. The gage was destroyed May 12. Replaced at same location and datum June 8.

Daily discharge, in second-feet, of North Fork of Big Timber Creek near Big Timber, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	15	29	78	.....	7.8	14	18	16
2	15	29	78	.....	7.8	14	18	18
3	15	32	96	.....	7.8	24	14	16
4	15	29	128	.....	9.5	24	14	18
5	15	21	106	.....	7.8	16	9.5	17
6	15	23	140	.....	7.8	18	6.2	.....
7	15	20	140	.....	7.8	18	7.8	.....
8	15	20	153	30	7.8	18	7.8	.....
9	17	20	158	30	18	24	7.8	.....
10	17	26	158	37	16	16	5.0	.....
11	23	26	158	37	16	18	7.8	.....
12	17	32	.....	37	9.5	18	9.5	.....
13	20	32	.....	37	7.8	30	6.2	.....
14	20	40	.....	34	7.8	24	30	.....
15	23	40	.....	37	21	16	30	.....
16	23	50	.....	37	24	18	27	.....
17	23	62	.....	34	18	12	34	.....
18	26	62	.....	30	18	7.2	34	.....
19	26	62	.....	30	18	12	34	.....
20	26	62	.....	30	16	7.8	30	.....
21	23	62	.....	18	18	12	30	.....
22	32	62	.....	18	18	12	27	.....
23	32	62	.....	18	16	12	21	.....
24	29	62	.....	14	16	24	30	.....
25	29	78	.....	9.5	14	18	34	.....
26	26	78	.....	9.5	16	24	.....	.....
27	23	87	.....	9.5	16	18	.....	.....
28	23	140	.....	7.8	16	9.5	.....	.....
29	23	140	.....	7.8	16	9.5	.....	.....
30	23	128	.....	7.8	12	7.8	.....	.....
31	26	.....	.....	.....	14	14	.....	.....

NOTE.—These discharges are based on a curve that is well defined below 110 second-feet. Above 24 second-feet it is the same as the 1909 curve.

Monthly discharge of North Fork of Big Timber Creek near Big Timber, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	32	15	[a] 20.8	1,280	B.
April	140	20	53.9	3,210	B.
May	158	30	[a] 75.1	4,620	C.
June	37	7.8	[a] 25.7	1,530	B.
July	24	7.8	13.7	842	B.
August	30	7.2	16.4	1,010	B.
September	34	5.0	[a] 20.3	1,210	B.
The period	.....	.....	.....	13,700	

[a] Discharge estimated Mar. 1 to 7, May 12 to June 7, and Sept. 26 to 30.

SOUTH FORK OF BIG TIMBER CREEK NEAR BIG TIMBER, MONT.

This station, which was established May 6, 1907, to determine the amount of water available for irrigation in connection with a Carey Act project, is located 1 mile above Tintinger's ranch, 15 miles northwest of Big Timber. The station is just above the junction with the North Fork.

The drainage area above the station is about 10 square miles. A few diversions are made, and practically all the water is appropriated.

A staff gage is used on the South Fork of Big Timber Creek. Its datum has remained constant. All measurements are made by wading near the gage.

Ice forms at this station during the winter months. The channel is practically permanent and fairly good results have been obtained during the open season.

Discharge measurements of South Fork of Big Timber Creek near Big Timber, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 8	W. A. Lamb	19	8.6	0.55	9.7
May 8	Raymond Richards	23	19	.95	44
June 8	W. A. Lamb	13	8.7	.66	16.7
July 9	Raymond Richards	13	8.2	.56	8.4
Aug. 18	C. S. Heidel	13	6.5	.48	6.1
Oct. 5	do	17	10.2	.61	14.1
Dec. 14[a]	do	11	5.7	.56	7.6

[a] Ice.

NOTE.—All measurements made by wading near gage.

Daily gage height, in feet, of South Fork of Big Timber Creek near Big Timber, Mont., for 1910.

[N. J. Tintinger, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	0.64	0.84	0.64	0.60	0.40	0.60	0.55
2	.....	.64	.89	.64	.60	.55	.65	.50
3	.....	.64	.94	.59	.60	.55	.50	.50
4	.....	.59	.96	.59	.55	.55	.60	.45
5	.....	.59	1.04	.64	.55	.40	.60	.61
6	.....	.59	1.04	.64	.55	.50	.50	.....
7	.....	.56	1.04	.64	.55	.50	.60	.....
8	0.54	.56	1.04	.59	.55	.55	.60	.....
9	.54	.56	1.04	.55	.55	.60	.60	.....
10	.54	.56	1.04	.60	.45	.48	.50	.....
11	.56	.59	1.04	.60	.55	.55	.60	.....
12	.56	.64	1.04	.60	.55	.55	.60	.....
13	.59	.69	1.04	.55	.55	.70	.50	.....
14	.59	.69	.64	.55	.55	.65	.70	.....
15	.59	.69	.59	.55	.55	.50	.75	.....
16	.59	.69	.59	.60	.55	.55	.65	.....
17	.59	.74	.64	.60	.55	.55	.75	.....
18	.59	.74	.64	.60	.45	.55	.75	.....
19	.64	.74	.64	.60	.45	.55	.70	.....
20	.66	.74	.59	.55	.35	.45	.60	.....
21	.64	.74	.54	.55	.45	.55	.65	.....
22	.69	.74	.79	.50	.45	.55	.65	.....
23	.69	.74	.74	.45	.45	.55	.50	.....
24	.66	.74	.64	.45	.40	.60	.65	.....
25	.66	.74	.74	.45	.40	.50	.70	.....
26	.64	.74	.64	.45	.40	.55	.....	.....
27	.64	.84	.64	.45	.40	.55	.....	.....
28	.64	1.04	.64	.50	.40	.55	.....	.....
29	.59	1.04	.64	.50	.40	.55	.....	.....
30	.59	.94	.64	.60	.30	.45	.....	.....
31	.64	.....	.74	.....	.40	.60	.....	.....

Daily discharge, in second-feet, of South Fork of Big Timber Creek near Big Timber, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	9	15	33	15	12	3.5	12	9.6
2	9	15	38	15	12	9.6	16	6.9
3	9	15	43	12	12	9.6	6.9	6.9
4	9	12	45	12	9.6	9.6	12	5.2
5	9	12	54	15	9.6	3.5	12	13
6	9	12	54	15	9.6	6.9	6.9	.....
7	9	10	54	15	9.6	6.9	12	.....
8	9	10	54	12	9.6	9.6	12	.....
9	9	10	54	9.6	9.6	12	12	.....
10	9	10	54	12	5.2	6.2	6.9	.....
11	10	12	54	12	9.6	9.6	12	.....
12	10	15	54	12	9.6	9.6	12	.....
13	12	19	54	9.6	9.6	20	6.9	.....
14	12	19	15	9.6	9.6	16	20	.....
15	12	19	12	9.6	9.6	6.9	24	.....
16	12	19	12	12	9.6	9.6	16	.....
17	12	23	15	12	9.6	9.6	24	.....
18	12	23	15	12	5.2	9.6	24	.....
19	15	23	15	12	5.2	9.6	20	.....
20	17	23	12	9.6	2.8	5.2	12	.....
21	15	23	9	9.6	5.2	9.6	16	.....
22	19	23	27	6.9	5.2	9.6	16	.....
23	19	23	23	5.2	5.2	9.6	6.9	.....
24	17	23	15	5.2	3.5	12	16	.....
25	17	23	23	5.2	3.5	6.9	20	.....
26	15	23	15	5.2	3.5	9.6	18	.....
27	15	33	15	5.2	3.5	9.6	16	.....
28	15	54	15	6.9	3.5	9.6	14	.....
29	12	54	15	6.9	3.5	9.6	12	.....
30	12	43	15	12	2.0	5.2	10	.....
31	15	.....	23	.....	3.5	12	.....	.....

NOTE.—These discharges are based on a curve that is well defined between 5 and 50 second-feet.

Monthly discharge of South Fork of Big Timber Creek near Big Timber, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	19	9	12.4	762	B.
April[a]	54	10	21.3	1,270	A.
May	54	9.0	30.2	1,860	A.
June	15	5.2	10.4	619	A.
July	12	2.0	7.14	439	A.
August	20	3.5	9.24	568	A.
September[a]	24	6.9	14.2	845	A.
The period	.....	.....	.....	6,360	

[a] Discharge estimated Mar. 1 to 7 and Sept. 26 to 30.

BOULDER RIVER BASIN.

BOULDER RIVER NEAR CONTACT, MONT.

Boulder River rises in the rugged mountains bordering Yellowstone Park. Below the station it traverses a narrow but well-irrigated country.

Because of its abundant water and rapid fall, this stream possesses many opportunities for water-power development as well as for irrigation.

The gaging station was established May 1, 1910, at the ranch of G. W. Baker, about 8 miles above McLeod post office, and 4 miles from Contact, Mont., and 2½ miles below Boulder Falls.

The gage is fastened to the left bank abutment of the private wagon bridge near the ranch buildings. Discharge measurements in low water may be made by wading just above the footbridge, which is some 400 yards above the gage. Ice is common.

Discharge measurements of Boulder River near Contact, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 10[a]	W. A. Lamb	56	87	2.60	132
10	do	72	96	2.60	140
June 10	Raymond Richards	120	236	4.25	1,000
July 7	do	75	145	3.52	540
27	C. S. Heidel	72	118	3.05	335
Sept. 3	do	65	70	2.36	105
Oct. 7	do	62	65	2.40	109
Dec. 16	do	58	56	2.03	33

[a] Made from bridge at Baker's ranch. Channel conditions poor.

Daily gage height, in feet, of Boulder River near Contact, Mont., for 1910.

[G. W. Baker, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.2	6.4	4.1	3.05	2.3	2.5	2.38	2.2
2	3.15	6.25	4.0	3.05	2.3	2.5	2.38	2.2
3	3.2	5.35	3.9	3.0	2.4	2.5	2.38	2.2
4	3.0	4.85	3.7	2.85	2.45	2.5	2.38	2.2
5	3.4	4.6	3.6	2.75	2.5	2.5	2.38	2.2
6	3.65	4.85	3.9	2.75	2.5	2.5	2.35	2.2
7	4.0	5.0	3.4	2.65	2.52	2.4	2.35	2.2
8	4.6	4.1	3.4	2.65	2.55	2.5	2.35	2.2
9	5.3	4.6	3.3	2.6	2.58	2.5	2.35	2.2
10	5.55	4.9	3.4	2.5	2.58	2.5	2.35	2.2
11	5.75	6.2	3.25	2.5	2.55	2.4	2.35	2.0
12	4.3	5.9	3.2	2.4	2.55	2.4	2.35	2.0
13	4.3	5.3	3.2	2.4	2.55	2.4	2.32	2.0
14	4.1	5.2	3.1	2.4	2.55	2.4	2.32	2.0
15	3.4	5.0	3.1	2.4	2.5	2.4	2.32	2.0
16	3.9	5.1	3.2	2.4	2.5	2.4	2.32	2.0
17	3.65	5.2	3.25	2.3	2.55	2.4	2.3	.....
18	3.9	5.0	3.3	2.3	2.6	2.4	2.3	.....
19	4.1	4.8	3.25	2.3	2.6	2.4	2.3	.....
20	4.05	5.15	3.2	2.3	2.6	2.4	2.3	.....
21	4.1	5.2	3.15	2.3	2.6	2.4	2.3	.....
22	4.05	4.8	3.2	2.25	2.6	2.4	2.3	.....
23	3.9	4.3	3.25	2.2	2.6	2.35	2.3	.....
24	4.25	4.2	3.25	2.15	2.6	2.35	2.3	.....
25	5.3	4.0	3.15	2.15	2.6	2.35	2.3	.....
26	5.4	3.8	3.15	2.1	2.6	2.35	2.3	.....
27	4.9	3.7	3.25	2.05	2.55	2.35	2.2	.....
28	4.4	3.6	3.15	2.1	2.55	2.35	2.2	.....
29	5.2	3.5	3.2	2.15	2.55	2.35	2.2	.....
30	5.4	3.5	3.15	2.2	2.55	2.35	2.2	.....
31	.....	.....	3.05	2.25	.....	.....	.....	.....

NOTE.—Ice after Dec. 16.

Daily discharge, in second-feet, of Boulder River near Contact, Mont., for 1910.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	396	2,440	904	331	86	139	106	64
2	374	2,380	840	331	86	139	106	64
3	396	1,760	778	310	111	139	106	64
4	310	1,410	659	256	125	139	106	64
5	493	1,240	601	221	139	139	106	64
6	630	1,410	778	221	139	139	98	64
7	840	1,510	493	186	145	111	98	64
8	1,240	904	493	186	154	139	98	64
9	1,720	840	443	170	164	139	98	64
10	1,900	1,440	493	139	164	139	98	64
11	2,040	2,370	420	139	154	111	98	32
12	1,040	2,140	396	111	154	111	98	32
13	1,040	1,720	396	111	154	111	91	32
14	904	1,650	352	111	154	111	91	32
15	493	1,510	352	111	139	111	91	32
16	778	1,580	396	111	139	111	91	32
17	630	1,650	420	86	154	111	86	.....
18	778	1,510	443	86	170	111	86	.....
19	904	1,370	420	86	170	111	86	.....
20	872	1,620	396	86	170	111	86	.....
21	904	1,650	374	86	170	111	86	.....
22	872	1,370	396	75	170	111	86	.....
23	778	1,040	420	64	170	98	86	.....
24	1,000	969	420	55	170	98	86	.....
25	1,720	840	374	55	170	98	86	.....
26	1,790	718	374	46	170	98	86	.....
27	1,440	659	420	39	154	98	64	.....
28	1,100	601	374	46	154	98	64	.....
29	1,650	545	396	55	154	98	64	.....
30	1,790	545	374	64	154	98	64	.....
31	2,120	.....	331	75	.....	102	.....	.....

NOTE.—These discharges are based on a rating curve that is fairly well defined below 1,170 second-feet. Discharges estimated Dec. 17 to 31.

Monthly discharge of Boulder River near Contact, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May	2,120	310	1,060	65,200	B.
June	2,440	545	1,380	82,100	B.
July	904	331	475	29,200	A.
August	331	39	131	8,060	A.
September	170	86	150	8,930	A.
October	139	98	115	7,070	A.
November	106	64	89.9	5,350	C.
December	64	.....	*a* 42.3	2,600	C.
The period				209,000	

a Discharge estimated for ice effect Dec. 17 to 31.

WEST FORK OF BOULDER RIVER NEAR BRUFFEYS, MONT.

This station, which is located at the highway bridge on the Livingston road about 7 miles from Bruffeys and 30 miles from Big Timber, was established May 7, 1904, by the State engineer of Montana, for the purpose of obtaining data in connection with irrigation projects. On May 4, 1907, it was transferred to the United States Geological Survey.

West Fork receives numerous small tributaries which enter from both sides above the station, the largest being Davis Creek, which

comes in from the west 1½ miles upstream. One small irrigation ditch above the station diverts 3 or 4 second-feet of water. The drainage area is 94 square miles.

The channel is composed of small bowlders and coarse gravel and is reasonably permanent. The gage datum has remained unchanged since the station was established and the results obtained are excellent for the entire open season. At times during the winter this stream is open, but during the greater part of this period the gage heights are affected by ice.

A staff gage is located on the bridge from which flood measurements are made. For low and medium stages better results may be obtained by wading.

Discharge measurements of West Fork of Boulder River near Bruffeys, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 9	W. A. Lamb	62	65	1.48	78
June 9	Raymond Richards	69	129	2.35	400
July 6	do	68	90	1.93	206
26	C. S. Heidel	63	68	1.62	119
Sept. 2	do	60	48	1.35	64
Oct. 6	do	60	51	1.40	68
Dec. 15[a]	do	60	44	1.30	42

[a] Ice.

Daily gage height, in feet, of West Fork of Boulder River near Bruffeys, Mont., for 1910.

[E. W. Gregory, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1	1.55	1.30	1.17	1.27	2.08	3.50	2.30	1.60
2	1.55	1.30	1.17	1.22	1.88	3.70	2.10	1.60
3	1.60	1.35	1.17	1.22	1.88	2.65	2.00	1.55
4	1.60	1.40	1.17	1.27	1.98	2.40	1.80	1.55
5	1.65	1.35	1.17	1.27	2.38	2.50	2.10	1.50
6	1.65	1.30	1.17	1.37	2.18	.....	1.93	1.50
7	1.70	1.40	1.17	1.37	2.43	2.80	.....	1.50
8	1.70	1.50	1.17	1.37	2.53	2.80	1.90	1.50
9	1.70	1.50	1.17	1.48	2.68	2.35	1.80	1.60
10	1.70	1.50	1.17	1.52	2.83	2.30	2.00	.....
11	1.70	1.50	1.17	1.67	2.88	2.80	1.90	.....
12	1.70	1.50	1.17	1.77	2.48	3.20	1.80	1.45
13	1.75	1.30	1.17	1.82	2.48	2.80	1.80	1.45
14	1.75	1.30	1.17	1.72	2.43	2.80	1.80	.....
15	1.75	1.20	1.17	1.52	2.38	2.70	1.80	1.40
16	1.75	1.40	1.17	1.57	2.28	2.90	1.80	1.40
17	1.75	1.60	1.17	1.67	.....	2.80	1.80	1.40
18	1.75	1.60	1.17	1.67	2.18	2.65	1.80	1.40
19	1.70	1.70	1.17	1.77	2.48	2.70	2.20	1.40
20	1.70	1.60	1.27	1.97	2.28	2.70	2.20	1.35
21	1.70	1.70	1.47	1.97	2.18	2.75	2.20	1.35
22	1.70	1.80	1.57	1.87	2.18	2.50	2.20	1.35
23	1.60	1.70	1.57	1.87	2.28	2.20	1.80	1.35
24	1.30	1.70	1.52	2.02	2.73	2.50	1.60	1.35
25	1.20	1.80	1.47	2.17	3.08	2.50	1.70	1.30
26	1.30	1.60	1.47	2.37	3.08	2.50	1.62	1.30
27	1.30	1.60	1.37	2.42	2.78	2.50	.....	1.30
28	1.30	1.50	1.37	2.72	2.68	2.40	1.70	.....
29	1.20	.....	1.27	2.57	2.58	2.35	1.70	.....
30	1.20	.....	1.17	2.27	2.88	2.35	1.70	.....
31	1.30	.....	1.37	.....	3.08	.....	1.60	.....

NOTE.—Gage heights Jan. 1 to Feb. 28 affected by ice. No observer after Aug. 27.

Daily discharge, in second-feet, of West Fork of Boulder River near Bruffeys, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Day.	Mar.	Apr.	May.	June.	July.	Aug.
1	35	49	269	1,230	373	110	16	35	103	363	758	164	69
2	35	42	190	1,400	277	110	17	35	128	338	686	164	69
3	35	42	190	582	235	99	18	35	128	314	582	164	69
4	35	49	227	427	164	99	19	35	155	473	616	323	69
5	35	49	416	485	277	88	20	49	224	363	616	323	61
6	35	63	314	586	208	88	21	82	224	314	651	323	61
7	35	63	444	686	202	88	22	103	187	314	485	323	61
8	35	63	504	686	197	88	23	103	187	363	323	164	61
9	35	84	603	400	164	110	24	92	243	637	485	110	61
10	35	92	708	373	235	99	25	82	309	890	485	135	53
11	35	128	744	686	197	88	26	82	411	890	485	115	53
12	35	155	473	985	164	78	27	63	439	672	485	125	53
13	35	171	473	686	164	78	28	63	630	603	427	135	.....
14	35	141	444	686	164	74	29	49	530	536	400	135	.....
15	35	92	416	616	164	69	30	35	358	744	400	135	.....
							31	63	.....	890	.....	110	.....

NOTE.—These discharges are based on a curve that is well defined below 830 second-feet. Discharges interpolated on dates with missing gage heights.

Monthly discharge of West Fork of Boulder River near Bruffeys, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	103	35	49.4	3,040	B.
April	630	42	185	11,000	A.
May	890	190	488	30,000	A.
June	1,400	323	613	36,500	A.
July	373	110	198	12,200	A.
August	110	53	[a] 75.3	4,630	A.
The period				97,400	

[a] Discharge Aug. 28 to 31 estimated.

WEST FORK OF BOULDER RIVER AT McLEOD, MONT.

This station was established May 4, 1907, at Koozer's private bridge, several hundred yards upstream from the highway bridge at McLeod post office, to determine the value of the stream for irrigation and power.

The West Fork has no important tributaries, deriving the greater part of its water from melting snow. It joins the main Boulder about one mile below the gaging station. The drainage area above the station is 137 square miles.

Water to irrigate about 800 acres of land is diverted above this station. A Carey Act project reclaiming 12,000 to 15,000 acres is now under investigation, the water to be diverted from the West Fork about 12 miles above the station.

The staff gage is fastened securely to a piling of the bridge near the right bank. The gage datum has remained unchanged. Measurements are made from this bridge or by wading. The bed of the stream is composed of bowlders and is rough but permanent. Ice forms during the winter months, but results obtained are good during the open season.

Discharge measurements of West Fork of Boulder River at McLeod, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 9	W. A. Lamb	40	50	0.70	86
11	do	54	74	.90	124
June 10	Raymond Richards	55	113	1.65	408
July 6	do	63	98	1.21	227
26	C. S. Heidel	54	80	.75	110
Sept. 3	do	48	62	.46	50
Oct. 7	do	51	65	.66	73
Dec. 16[a]	do	28	26	.....	33

[a] Ice conditions.

Daily gage height, in feet, of West Fork of Boulder River at McLeod, Mont., for 1910.

[Clyde Curtis, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.9	1.6	0.5	0.5	0.6	0.6	0.55
2	.....	3.0	1.5	.5	.5	.7	.6	.55
3	.....	2.1	1.4	.5	.45	.7	.6	.5
4	.....	1.8	1.4	.4	.45	.7	.55	.5
5	.....	2.0	1.4	.4	.6	.6	.55	.5
6	.....	2.0	1.3	.4	.65	.6	.55	.5
7	.....	2.2	1.3	.4	.65	.6	.55	.5
8	.....	2.4	1.2	.4	.55	.6	.55	.55
9	.....	1.8	1.2	.4	.55	.6	.6	.6
10	.....	1.7	1.2	.4	.55	.6	.6	.55
11	.....	2.1	1.1	.4	.55	.6	.55	.....
12	.....	2.7	1.1	.3	.6	.6	.55	.....
13	.....	2.1	1.0	.3	.6	.6	.55	.....
14	.....	2.3	1.0	.25	.7	.6	.55	.....
15	.....	2.2	1.0	.2	.6	.6	.55	.....
16	.....	2.3	1.0	.2	.6	.6	.5	.....
17	.....	2.2	.9	.2	.6	.6	.5	.....
18	.....	2.3	.9	.2	.6	.65	.5	.....
19	.....	2.2	1.0	.2	.6	.65	.5	.....
20	.....	2.4	1.0	.25	.7	.65	.5	.....
21	.....	2.2	1.3	.25	.7	.6	.5	.....
22	.....	1.9	1.1	.3	.7	.6	.5	.....
23	.....	1.7	.9	.3	.75	.6	.5	.....
24	.....	1.7	.8	.3	.8	.6	.5	.....
25	.....	1.7	.8	.5	.8	.6	.5	.....
26	.....	1.7	.7	.4	.7	.6	.5	.....
27	.....	1.7	.7	.4	.7	.6	.5	.....
28	.....	1.7	.7	.4	.65	.6	.5	.....
29	2.0	1.7	.7	.4	.65	.6	.5	.....
30	2.3	1.7	.6	.5	.6	.6	.55	.....
31	2.7	.....	.6	.6	.....	.6	.....	.....

NOTE.—Ice after Dec. 10.

Daily discharge, in second-feet, of West Fork of Boulder River at McLeod, Mont., for 1910.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1,280	390	56	56	69	69	62
2	.....	1,370	345	56	56	85	69	62
3	.....	660	305	56	50	85	69	56
4	.....	490	305	45	50	85	62	56
5	.....	600	305	45	69	69	62	56
6	.....	600	265	45	76	69	62	56
7	.....	725	265	45	76	69	62	56
8	.....	860	230	45	62	69	62	62
9	.....	490	230	45	62	69	69	69
10	.....	440	230	45	62	69	69	62

Daily discharge, in second-feet, of West Fork of Boulder River, at McLeod, Mont., for 1910—Continued.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov	Dec.
11		660	195	45	62	69	62	
12		1,100	195	36	69	69	62	
13		660	160	36	69	69	62	
14		790	160	32	85	69	62	
15		725	160	28	69	69	62	
16		790	160	28	69	69	56	
17		725	130	28	69	69	56	
18		790	130	28	69	77	56	
19		725	160	28	69	77	56	
20		860	160	32	85	77	56	
21		725	265	32	85	69	56	
22		545	195	36	85	69	56	
23		440	130	36	95	69	56	
24		440	105	36	105	69	56	
25		440	105	56	105	69	56	
26		440	85	45	85	69	56	
27		440	85	45	85	69	56	
28		440	85	45	76	69	56	
29	600	440	85	45	76	69	56	
30	790	440	69	56	69	69	62	
31	1,100		69	69		69		

NOTE.—These discharges are based on a well-defined rating curve. Discharges estimated Dec. 11 to 15 and 17 to 31.

Monthly discharge of West Fork of Boulder River at McLeod, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
June	1,370	440	671	39,900	A.
July	390	69	186	11,400	A.
August	69	28	42.1	2,590	A.
September	105	50	73.3	4,360	A.
October	85	69	71.3	4,380	A.
November	69	56	60.4	3,590	A.
December[a]	69	33	43.5	2,670	C.
The period				67,600	

[a] Discharge estimated Dec. 11 to 31 on basis of measurement made Dec. 16.

SWEETGRASS CREEK BASIN.

SWEETGRASS CREEK ABOVE MELVILLE, MONT.

Sweetgrass Creek rises in the Crazy Mountains and flows southeastward to the Yellowstone, which it joins a short distance below Big Timber. It has no important tributaries. The drainage area is about 47 square miles.

The gaging station, which was established May 5, 1907, to determine the amount of water available for irrigation, storage, and power, is located at C. M. Rein's ranch, 16 miles northwest of Melville and 35 miles from Big Timber, on the site of a reservoir proposed under the Carey Act.

A few small ditches divert water above the station. The stream freezes over during the winter months.

When the station was established, a secondary staff gage, to be used during extreme high water, was installed at a different datum about 300 feet below the regular gage. During the high water of June and July, 1908, the regular gage was undermined and after August 19 readings were discontinued. Beginning October 1, 1908, all gage heights refer to the secondary gage, which is nailed to lower side (right bank) of the footbridge directly behind ranch buildings of observer. The new gage heights are not comparable with the old ones. Discharge measurements are made by wading near the gage at ordinary stages; at high stages a footbridge is used.

The stream bed is composed of rough gravel.

Discharge measurements of Sweetgrass Creek above Melville, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 8	W. A. Lamb	24	17	1.40	14
May 7	Raymond Richards	54	85	2.52	281
July 9	C. S. Heidel	38	62	2.03	105
Aug. 18	....do	30	42	1.72	41
Oct. 5	....do	36	45	1.97	83
Dec. 14	....do	31	34	1.62	25

Daily gage height, in feet, of Sweetgrass Creek above Melville, Mont., for 1910.

[C. M. Rein, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.43	2.26	2.78	2.15	1.85	1.66	1.96	1.82	1.63
2	.....	1.43	2.20	2.83	2.15	1.85	1.66	1.96	1.82	1.63
3	.....	1.43	2.17	2.41	2.12	1.85	1.63	1.96	1.80	1.63
4	.....	1.43	2.14	2.28	2.10	1.85	1.63	.....	1.80	1.61
5	.....	1.43	2.31	2.24	2.08	1.83	1.63	1.97	1.78	1.61
6	.....	.....	2.38	2.21	2.07	1.83	1.63	.....	.....	.....
7	.....	1.41	2.56	2.41	2.05	1.82	1.66	1.96	1.76	.....
8	.....	1.41	2.86	2.44	2.05	1.82	1.68	1.96	1.76	1.61
9	.....	1.43	2.96	2.28	2.02	1.80	1.66	1.96	1.76	1.61
10	.....	1.44	2.96	2.30	2.02	1.80	1.65	1.96	1.76	1.61
11	.....	1.45	2.78	2.42	2.00	1.77	1.65	1.96	.....	1.61
12	.....	1.45	2.50	2.56	1.99	1.77	.....	1.96	1.73	.....
13	1.49	1.46	2.42	2.54	1.97	1.75	1.65	1.96	1.73	.....
14	1.48	1.48	2.41	2.51	1.97	1.75	1.65	1.96	1.73	1.62
15	.....	1.51	2.34	2.52	1.95	1.75	1.65	1.95	1.73	1.62
16	1.46	1.51	2.25	2.66	1.95	1.72	1.65	1.95	1.73	1.62
17	1.46	1.53	2.20	2.61	1.93	1.72	1.65	1.95	1.73	1.62
18	.....	1.53	2.20	2.54	1.93	1.72	1.65	1.93	1.72	1.62
19	1.43	1.54	2.22	2.51	1.92	1.72	1.65	1.93	1.72	1.62
20	1.43	1.57	2.27	2.48	1.92	.....	1.65	1.93	.....	1.61
21	1.43	1.57	2.28	2.61	1.92	.....	1.65	1.91	.....	1.61
22	1.43	1.61	2.28	2.52	1.91	1.70	1.80	1.91	1.68	.....
23	1.43	1.61	2.48	2.25	1.89	1.70	1.90	1.90	1.68	.....
24	1.43	1.63	2.47	2.23	1.89	1.70	1.96	1.90	.....	1.60
25	1.43	1.65	2.71	2.21	1.89	1.69	1.90	1.90	1.68	1.59
26	1.43	1.88	2.74	2.20	1.87	1.69	1.95	1.88	1.68	.....
27	1.43	2.38	2.62	2.18	1.87	1.69	1.96	1.88	.....	.....
28	.....	2.77	2.49	2.16	1.87	1.67	1.96	1.88	.....	.....
29	1.43	2.80	2.41	2.14	1.86	1.67	1.96	1.86	.....	.....
30	1.43	2.42	2.56	2.15	1.85	1.67	1.96	1.84	1.63	.....
31	1.43	.....	2.78	.....	.....	1.65	.....	1.84	.....	.....

NOTE.—Ice in January and February and after Dec. 25.

Daily discharge, in second-feet, of Sweetgrass Creek above Melville, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	18	178	392	142	62	30	88	56	26
2	.....	18	158	415	142	62	30	88	56	26
3	.....	18	149	233	133	62	26	88	52	26
4	.....	18	139	185	127	62	26	89	52	23
5	.....	18	196	172	121	58	26	90	49	23
6	.....	17	222	161	118	58	26	89	47	23
7	.....	16	294	233	112	56	30	88	45	23
8	.....	16	430	245	112	56	32	88	45	23
9	.....	18	477	185	104	52	30	88	45	23
10	.....	18	477	192	104	52	28	88	45	23
11	.....	18	392	237	98	47	28	88	42	23
12	.....	18	269	294	95	47	28	88	40	24
13	20	18	237	286	90	44	28	88	40	24
14	20	20	233	273	90	44	28	88	40	25
15	20	22	207	277	86	44	28	86	40	25
16	19	22	175	337	86	38	28	86	40	25
17	19	24	158	315	80	38	28	86	40	25
18	18	24	158	286	80	38	28	80	38	25
19	18	25	165	273	78	38	28	80	38	25
20	18	27	172	261	78	37	28	80	36	23
21	18	27	185	315	78	36	28	76	34	23
22	18	31	185	277	76	35	52	76	32	23
23	18	31	261	175	71	35	73	73	32	22
24	18	34	257	168	71	35	88	73	32	22
25	18	36	360	161	71	34	73	73	32	21
26	18	77	369	158	67	34	86	69	32	.....
27	18	239	320	152	67	34	88	69	31	.....
28	18	387	265	146	67	31	88	69	30	.....
29	18	401	233	139	65	31	88	65	28	.....
30	18	237	294	142	62	31	88	60	26	.....
31	18	.....	392	.....	62	28	.....	60	.....	.....

NOTE.—These discharges are based on rating curves applicable as follows: Mar. 13 to Apr. 27, fairly well defined; Apr. 28 to Dec. 25, well defined above 20 second-feet. Discharge interpolated for days having no gage heights.

Monthly discharge of Sweetgrass Creek above Melville, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	[1] 22	1,350	
February	.....	.....	[1] 19	1,060	
March	20	18	[1] 19.0	1,170	C.
April	401	16	63.1	3,750	B.
May	477	139	258	15,900	A.
June	415	139	236	14,000	A.
July	142	62	91.4	5,620	A.
August	62	28	43.8	2,690	A.
September	88	26	43.9	2,610	A.
October	90	60	80.5	4,950	A.
November	56	26	39.8	2,370	A.
December	26	20	[1] 23.0	1,410	B.
The year	.....	.....	78.3	56,900	

[1] Discharge estimated Jan. 1 to Mar. 12 and Dec. 26 to 31.

NOTE.—The means for January and February are only approximate.

SWEETGRASS CREEK BELOW MELVILLE, MONT.

This station, which was established May 4, 1907, to determine the amount of water available for irrigation, was located at Adams ranch, 9 miles below Melville, 20 miles from Big Timber, and 2½ miles below the head gate of the Glass-Lindsay Land Co.'s canal, a Carey Act

Monthly discharge of Pennington Creek below Melville, Mont., for 1910.

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off in inches.
	Maximum.	Minimum.	Mean.		
April	53	30	47.4	2,820	.4
May	58	40	53	3,258	.4
June	51	37	43	2,558	.3
July	47	31	38.4	2,360	.3
August	40	31	37.4	2,299	.3
September	39	30	33.5	1,993	.3
October	38	29	32.9	2,023	.3
November	34	26	30.1	1,791	.2
December			4.38	269	.0
The year			40.4	29,300	

a Discharge interpolated on basis of correspondence of Dec. 31 and by comparison with upper stations.

STILLWATER RIVER BASIN.

STILLWATER RIVER NEAR ABSAROKEE, MONT.

Stillwater River rises in the rugged mountains bordering Yellowstone Park, and flows northeastward to its junction with Yellowstone River near Columbus.

The territory bordering Stillwater is well irrigated. The river has a heavy fall and carries an abundance of water, and therefore affords excellent opportunity for the development of hydroelectric power.

The gaging station was established July 19, 1910, on the public highway bridge crossing the stream at the Riverside Road House, 12 miles southwest of Columbus, Mont. Rosebud Creek enters the river a mile above the station.

A staff gage is nailed to right abutment pier on upstream side of bridge. Discharge measurements are made from the lower side of the bridge.

The bed of the stream is composed of gravel and bowlders and is very rough but will not shift.

Ice is common at the gaging section in extreme cold weather.

Discharge measurements of Stillwater River near Absarokee, Mont., in 1910.

Date.	Hydrographer.	Gage height.	Area of section.	Discharge.	Gage height.
		Feet.	Sq. ft.	Feet.	Sec.-ft.
July 19	Raymond Hoffman	3.7	40.6	2.44	2,360
Aug. 3	do	3.6	38.6	2.42	2,320
Aug. 31	J. C. Hoyer	3.5	37.1	2.40	2,220
Sept. 9	W. A. Lamb	3.4	36.1	2.39	2,160

Daily gage height, in feet, and discharge, in second-feet, of Stillwater River near Absarokee, Mont., for 1910.

[James Bennet, observer.]

Day.	July.		Aug.		Sept.		Oct.		Nov.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			1.8	1,180	0.8	465	0.9	520	0.7	415
2			1.8	1,180	.8	465	.9	520	.7	415
3			1.7	1,100	.8	465	.9	520	.7	415
4			1.6	1,020	.8	465	.9	520	.8	465
5			1.5	940	.8	465	.9	520	.8	465
6			1.5	940	.8	465	.8	465	.8	465
7			1.5	940	.7	415	.8	465	.8	465
8			1.4	965	.7	415	.8	465	.7	415
9			1.4	965	.7	415	.8	465	.5	330
10			1.3	890	.7	415	.8	465	.5	330
11			1.3	890	.8	465	.8	465	.55	350
12			1.3	890	.8	465	.8	465	.55	350
13			1.6	1,020	.8	465	.8	465	.55	350
14			1.5	940	.8	465	.7	415	.6	370
15			1.4	965	.7	415	.7	415	.6	370
16			1.3	890	.7	415	.7	415	.6	370
17			1.2	720	.8	465	.7	415	.6	370
18			1.2	720	.9	520	.8	465	.6	370
19	2.7	2,070	1.1	650	.9	520	.8	465	.6	370
20	2.75	2,120	1.1	650	.9	520	.8	465	.6	370
21	3.4	2,860	1.1	650	1.2	720	.8	465	.65	392
22	3.4	2,800	1.1	650	1.4	965	.7	415	.65	392
23	3.0	2,400	1.1	650	1.4	965	.7	415	.7	415
24	2.72	2,090	1.1	650	1.4	965	.7	415	.7	415
25	2.4	1,760	1.1	650	1.5	940	.7	415	.65	392
26	2.2	1,560	1.0	580	1.3	890	.8	465	.7	415
27	2.2	1,560		555	1.2	720	.8	465	.75	440
28	2.05	1,420		535	1.1	650	.7	415	.8	465
29	2.0	1,370		510	1.1	650	.7	415	.8	465
30	1.9	1,280		485	1.0	580	.7	415	.7	415
31	1.85	1,230	.8	465			.7	415		

NOTE.—Ice during December. The discharges are based on a well-defined rating curve.

Monthly discharge of Stillwater River near Absarokee, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
July 19–31	2,860	1,230	1,890	48,700	A.
August	1,180	465	801	49,300	A.
September	965	415	574	34,200	A.
October	520	415	455	28,000	B.
November	465	330	401	23,900	B.

ROSEBUD RIVER AT ABSAROKEE, MONT.

Rosebud River rises in several small lakes in the high mountains bordering Yellowstone Park, flows northwestward, and unites with Stillwater River near Absarokee.

The gaging station was established July 19, 1910, on the highway bridge just west of Absarokee, Mont., and 14 miles from Columbus, about 1 mile above the mouth of the stream. There are no important tributaries above the station other than the many forks of the stream itself.

Monthly discharge of Sweetgrass Creek below Melville, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	371	39	87.4	5,200	A.
May	386	89	191	11,700	A.
June	267	67	157	9,340	A.
July	67	16	35.4	2,180	A.
August	40	23	27.8	1,710	A.
September	95	23	45.6	2,710	A.
October	105	52	75.9	4,670	A.
November	76	40	50.1	2,980	A.
December			[a] 56	3,440	C.
The year			65.4	43,900	

[a] Discharge estimated on basis of ice measurements of Dec. 13 and by comparison with upper station.

STILLWATER RIVER BASIN.

STILLWATER RIVER NEAR ABSAROKEE, MONT.

Stillwater River rises in the rugged mountains bordering Yellowstone Park, and flows northeastward to its junction with Yellowstone River near Columbus.

The territory bordering Stillwater is well irrigated. The river has a heavy fall and carries an abundance of water, and therefore affords excellent opportunity for the development of hydroelectric power.

The gaging station was established July 19, 1910, on the public highway bridge crossing the stream at the Riverside Road House, 13 miles southwest of Columbus, Mont. Rosebud Creek enters the river a mile above the station.

A staff gage is nailed to right abutment pier on upstream side of bridge. Discharge measurements are made from the lower side of the bridge.

The bed of the stream is composed of gravel and bowlders and is very rough but will not shift.

Ice is common at the gaging section in extreme cold weather.

Discharge measurements of Stillwater River near Absarokee, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 19	Raymond Richards	147	469	2.68	2,060
Aug. 3	do	146	366	1.82	1,210
Aug. 31	J. C. Beebe	137	272	.80	553
Nov. 9	W. A. Lamb	124	196	.52	322

Daily gage height, in feet, and discharge, in second-feet, of Stillwater River near Absarokee, Mont., for 1910.

[James Bennet, observer.]

Day.	July.		Aug.		Sept.		Oct.		Nov.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			1.8	1,180	0.8	465	0.9	520	0.7	415
2			1.8	1,180	.8	465	.9	520	.7	415
3			1.7	1,100	.8	465	.9	520	.7	415
4			1.6	1,020	.8	465	.9	520	.8	465
5			1.5	940	.8	465	.9	520	.8	465
6			1.5	940	.8	465	.8	465	.8	465
7			1.5	940	.7	415	.8	465	.8	465
8			1.4	965	.7	415	.8	465	.7	415
9			1.4	965	.7	415	.8	465	.5	330
10			1.3	890	.7	415	.8	465	.5	330
11			1.3	890	.8	465	.8	465	.55	350
12			1.3	890	.8	465	.8	465	.55	350
13			1.6	1,020	.8	465	.8	465	.55	350
14			1.5	940	.8	465	.7	415	.6	370
15			1.4	965	.7	415	.7	415	.6	370
16			1.3	890	.7	415	.7	415	.6	370
17			1.2	720	.8	465	.7	415	.6	370
18			1.2	720	.9	520	.8	465	.6	370
19	2.7	2,070	1.1	650	.9	520	.8	465	.6	370
20	2.75	2,120	1.1	650	.9	520	.8	465	.6	370
21	3.4	2,860	1.1	650	1.2	720	.8	465	.65	392
22	3.4	2,860	1.1	650	1.4	965	.7	415	.65	392
23	3.0	2,400	1.1	650	1.4	965	.7	415	.7	415
24	2.72	2,090	1.1	650	1.4	965	.7	415	.7	415
25	2.4	1,760	1.1	650	1.5	940	.7	415	.65	392
26	2.2	1,560	1.0	580	1.3	890	.8	465	.7	415
27	2.2	1,560	.....	555	1.2	720	.8	465	.75	440
28	2.05	1,420	.....	535	1.1	650	.7	415	.8	465
29	2.0	1,370	.....	510	1.1	650	.7	415	.8	465
30	1.9	1,280	.....	485	1.0	580	.7	415	.7	415
31	1.85	1,230	.8	465	.....	.....	.7	415	.....	.....

NOTE.—Ice during December. The discharges are based on a well-defined rating curve.

Monthly discharge of Stillwater River near Absarokee, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
July 19–31	2,860	1,230	1,890	48,700	A.
August	1,180	465	801	49,300	A.
September	965	415	574	34,200	A.
October	520	415	455	28,000	B.
November	465	330	401	23,900	B.

ROSEBUD RIVER AT ABSAROKEE, MONT.

Rosebud River rises in several small lakes in the high mountains bordering Yellowstone Park, flows northwestward, and unites with Stillwater River near Absarokee.

The gaging station was established July 19, 1910, on the highway bridge just west of Absarokee, Mont., and 14 miles from Columbus, about 1 mile above the mouth of the stream. There are no important tributaries above the station other than the many forks of the stream itself.

A staff gage is fastened to the downstream side of left abutment pier of the bridge. Discharge measurements are made from the downstream side of the bridge.

The bed of stream is composed of gravel and bowlders, and is not likely to shift. The flow at this station is practically unaffected by ice.

Irrigation is practiced considerably above the station.

Discharge measurements of Rosebud River at Absarokee, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 19	Raymond Richards	75	236	1.18	1,010
Aug. 3	do	74	204	.86	661
31	J. C. Beebe	69	156	.24	283
Nov. 10	W. A. Lamb	69	130	.00	178

Daily gage height, in feet, and discharge, in second-feet, of Rosebud River at Absarokee, Mont., for 1910.

[Chris Carstens, observer.]

Day.	July.		Aug.		Sept.		Oct.		Nov.		Dec.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1	.....	.....	1.1	910	0.3	299	.....	1532	0.1	209	0.2	252
2	.....	.....	1.1	910	.3	299	0.4	352	.1	209	.2	252
3	.....	.....	.9	715	.2	252	.4	352	.1	209	.2	252
4	.....	.....	.9	715	.1	219	.4	352	.1	209	.2	252
5	.....	.....	1.1	910	.1	219	.3	299	.1	209	.2	252
6	.....	.....	1.1	910	.25	276	.3	299	.1	209	.2	252
7	.....	.....	1.0	810	.1	209	.2	252	.1	209	.2	252
8	.....	.....	.9	715	.1	209	.2	252	.1	209	.25	276
9	.....	.....	.7	552	.15	230	.2	252	.1	209	.25	276
10	.....	.....	.5	412	.2	252	.2	252	.1	209	.25	276
11	.....	.....	.5	412	.2	252	.2	252	.1	209	.25	276
12	.....	.....	.5	412	.2	252	.1	209	.1	209	.25	276
13	.....	.....	.5	412	.2	252	.1	209	.1	209	.25	276
14	.....	.....	.5	412	.2	252	.1	209	.1	209	.25	276
15	.....	.....	.5	412	.1	209	.1	209	.1	209	.25	276
16	.....	.....	.5	412	.1	209	.1	209	.1	209	.25	276
17	.....	.....	.6	480	.1	209	.1	209	.1	209	.25	276
18	.....	.....	.5	412	.3	299	.2	252	.1	209	.....	260
19	1.2	1,020	.5	412	.3	299	.2	252	.1	209	.....	260
20	1.3	1,140	.5	412	.5	412	.2	252	.1	209	.....	260
21	1.5	1,390	.5	412	.7	552	.1	209	.1	209	.....	260
22	1.8	1,800	.5	412	.9	715	.1	209	.1	209	.....	260
23	1.7	1,660	.5	412	.9	715	.1	209	.2	252	.....	260
24	1.6	1,520	.6	480	.....	[a]762	.1	209	.2	252	.....	250
25	1.4	1,260	.6	480	1.0	810	.1	209	.2	252	.....	250
26	1.2	1,020	.5	412	1.2	1,020	.1	209	.2	252	.....	250
27	1.1	910	.5	412	1.4	1,260	.1	209	.2	252	.....	250
28	1.1	910	.4	352	1.5	1,390	.1	209	.2	252	.....	250
29	1.1	910	.4	352	1.0	810	.1	209	.2	252	.....	250
30	1.1	910	.3	299	.9	715	.1	209	.2	252	.....	250
31	1.1	910	.3	299	.....	.....	.1	209	.....	.....	.....	250

[a] Interpolated.

NOTE.—Discharge affected by ice after Dec. 17. The discharges are based on a curve that is fairly well defined.

Monthly discharge of Rosebud River at Absarokee, Mont., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
July 19–31	1,800	910	1,180	30,400	B.
August	910	299	518	31,900	B.
September	1,390	209	462	27,500	B.
October	532	209	250	15,400	B.
November	252	209	220	13,100	B.
December	276	250	261	16,000	C.

CLARK FORK BASIN.

CLARK FORK AT FROMBERG, MONT.

Clark Fork enters Yellowstone River from the south about 15 miles southwest of Billings, Mont. The stream is bordered by irrigable land which is used for agriculture.

The gaging station, which was established June 3, 1905, to determine the amount of water available for irrigation, is located on the highway bridge one-half mile east of the Northern Pacific Railway station at Fromberg, Mont.

One small stream, Red Rock Creek, flows into the river between the gaging station and its mouth. The drainage area above the station is about 2,500 square miles. (See fig. 1, p. 166.)

As almost all the valley land is under irrigation, many diversions are made, but owing to the abundance of water only a small portion of the flow is used.

The ice period ranges from December to the middle of March, but frequently during this period the river breaks up and floating ice may be seen.

The original staff gage has been replaced by a standard chain gage fastened to the upstream side of the bridge, but no change in gage datum has occurred. Records obtained are excellent. The gaging section, which is from the bridge, would be ideal if it were not for the middle pier of the bridge, which divides the channel. The bed of the stream is composed of rock and gravel, is free from vegetation, and is permanent.

All estimates of discharge for this station have been revised in the light of recent measurements and are published herewith. Gage heights for years 1905 to 1909 may be found in Water-Supply Papers 172, page 102; 208, pages 92, 93; 246, pages 173, 174; and 266, page 166.

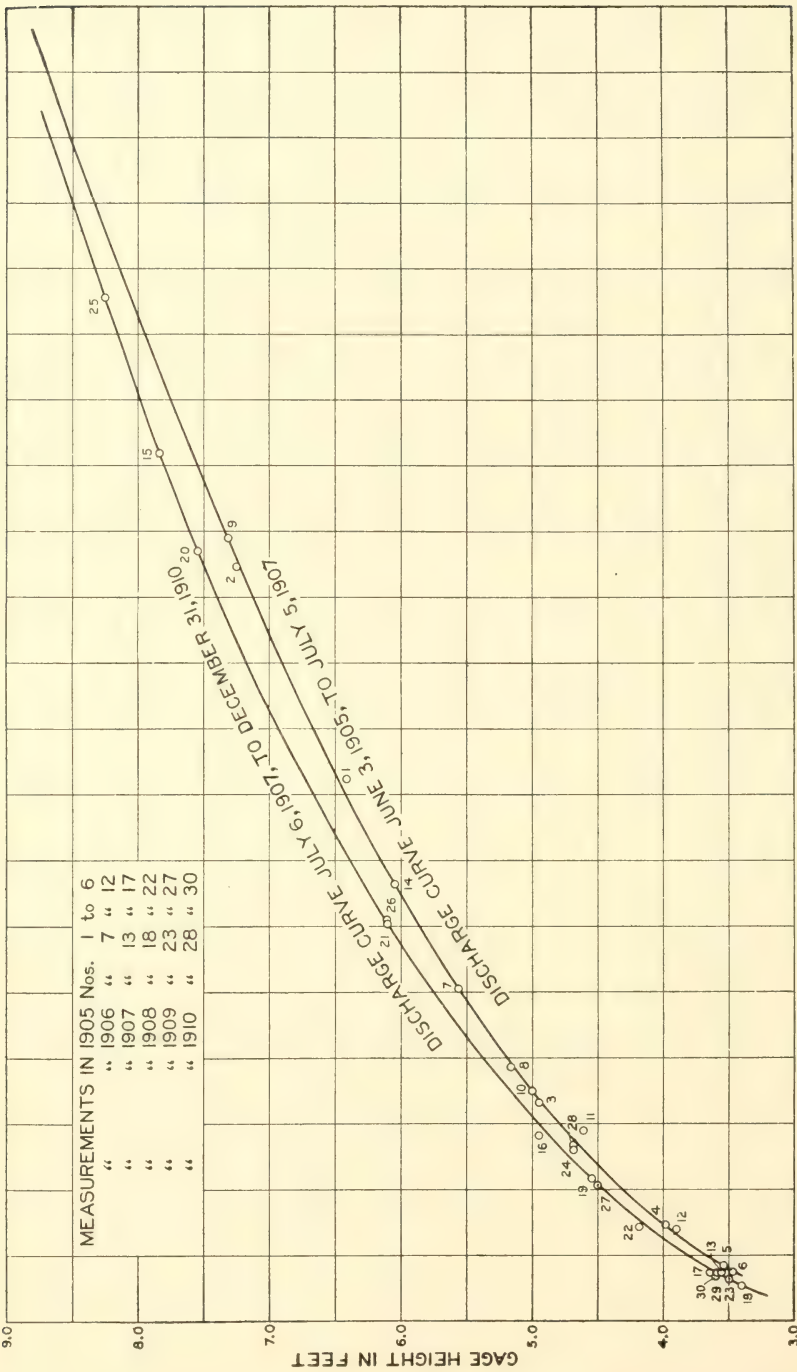

FIGURE 1.—Discharge curve for Clark Fork at Fromberg, Mont.

Discharge measurements of Clark Fork at Fromberg, Mont., in 1905–1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 3	J. H. Sloan	209	845	6.42	4,120
27	....do	185	578	4.95	1,660
July 25	....do	210	970	7.25	5,730
Aug. 19	....do	135	370	3.98	734
Sept. 16	....do	122	309	3.53	416
Oct. 17	....do	122	289	3.47	372
1906.					
May 12	H. M. Morse	190	637	5.57	2,530
June 2	Morse and Whinery	168	534	5.17	1,930
15	R. H. Whinery	209	1,010	7.32	5,950
26	....do	170	493	5.00	1,750
July 28	Richards and Whinery	165	479	4.62	1,450
Sept. 4	Raymond Richards	130	348	3.90	696
1907.					
Apr. 10	J. E. Stewart	120	288	3.56	374
June 1[a]	....do	207	733	6.04	3,320
July 12	....do	214	1,130	7.83	6,590
Aug. 17	....do	184	526	4.95	1,410
Nov. 12[b]	....do	125	310	3.64	370
1908.					
Mar. 30	J. E. Stewart	118	263	3.40	269
May 22	....do	158	438	4.54	1,080
June 13	Raymond Richards	211	1,090	7.55	5,850
July 20	....do	206	750	6.10	3,030
Oct. 10	J. E. Stewart	143	375	4.18	717
1909.					
Apr. 5	Raymond Richards	123	295	3.50	320
May 22	....do	183	470	4.68	1,300
June 24	....do	230	1,210	8.25	7,780
July 17	J. E. Stewart	210	780	6.11	3,050
Sept. 13	Raymond Richards	151	446	4.49	1,030
1910.					
July 16	Raymond Richards	165	505	4.68	1,330
Aug. 30	J. C. Beebe	126	330	3.58	368
Nov. 11	Wm. A. Lamb	105	275	3.60	346

[a] Measurement made without sufficient amount of lead. [b] Slight ice effect.

Daily gage height, in feet, of Clark Fork at Fromberg, Mont., for 1910.

[Mrs. E. V. Moran, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.05	4.1	5.4	7.6	5.5	4.4	3.6	3.5	3.6	3.6
2	4.0	4.05	5.5	7.6	5.5	4.35	3.6	3.5	3.5	3.65
3	4.2	4.0	5.5	7.6	5.4	4.3	3.6	3.5	3.5	3.7
4	4.2	4.0	5.5	7.6	5.35	4.3	3.6	3.5	3.5	3.7
5	4.15	3.9	5.8	7.7	5.3	4.3	3.5	3.5	3.4	3.7
6	4.35	3.9	5.65	7.6	5.2	4.1	3.5	3.5	3.4	3.7
7	4.5	3.8	5.6	7.75	5.2	4.1	3.5	3.5	3.4	3.7
8	4.5	3.8	5.7	7.65	4.95	4.1	3.5	3.5	3.4	3.7
9	4.5	3.8	5.7	7.45	4.9	4.1	3.5	3.5	3.5	3.7
10	4.4	3.6	5.6	7.15	4.7	3.8	3.5	3.5	3.5	3.7
11	4.35	3.6	5.8	6.85	4.7	3.8	3.5	3.5	3.6	3.5
12	4.3	3.6	6.1	6.8	4.6	3.8	3.5	3.5	3.6	3.5
13	4.05	3.6	6.55	6.75	4.5	3.8	3.5	3.6	3.5	3.5
14	3.85	3.75	6.0	7.0	4.7	3.8	3.5	3.6	3.5	3.5
15	3.65	3.8	5.85	7.15	4.7	3.8	3.5	3.6	3.5	3.5
16	3.6	3.8	5.8	7.05	4.65	3.8	3.5	3.55	3.5	3.5
17	3.6	3.95	5.8	7.0	4.7	3.8	3.5	3.5	3.5	3.45
18	3.7	4.1	5.8	6.65	4.5	3.8	3.5	3.5	3.5	3.45
19	3.7	4.2	5.55	6.6	4.5	3.75	3.5	3.5	3.5	3.4
20	3.7	4.5	5.6	6.55	4.5	3.7	3.5	3.5	3.5	3.4

Daily gage height, in feet, of Clark Fork at Fromberg, Mont., for 1910—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	3.7	4.5	5.6	6.6	4.65	3.7	3.6	3.5	3.5	3.4
22	3.8	4.5	5.65	6.5	4.85	3.7	3.6	3.5	3.5	3.4
23	3.8	4.8	5.7	6.35	4.8	3.75	3.6	3.5	3.5	3.4
24	3.8	4.7	5.85	6.35	4.8	3.8	3.6	3.5	3.5	3.4
25	3.9	5.0	5.75	6.35	4.7	3.8	3.75	3.5	3.5	3.4
26	4.0	5.0	6.0	6.3	4.7	3.7	3.95	3.5	3.5	3.4
27	4.0	5.15	6.2	6.05	4.7	3.7	3.9	3.5	3.5	3.4
28	3.95	5.1	6.35	5.95	4.6	3.7	3.8	3.5	3.5	3.4
29	4.0	5.3	6.45	5.75	4.6	3.7	3.75	3.5	3.6	3.4
30	4.1	5.3	6.8	5.55	4.5	3.7	3.5	3.5	3.7	3.4
31	4.1	.....	6.9	.....	4.45	3.6	.....	3.5	.....	3.4

NOTE.—Ice during January and February.

Daily discharge, in second-feet, of Clark Fork at Fromberg, Mont., for 1905–1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
1							4,360	1,430	602	400	400	.....
2							4,260	1,380	554	400	400	.....
3						4,160	3,740	1,690	533	400	400	.....
4						5,100	3,580	1,880	507	323	446	.....
5						5,780	3,500	1,520	489	323	458	.....
6						4,260	3,060	1,300	458	346	429	.....
7						3,320	3,140	1,190	458	346	429	.....
8						3,680	3,230	1,190	429	346	429	.....
9						6,260	3,230	1,080	429	346	400	.....
10						5,440	3,230	980	429	346	400	.....
11						3,860	3,260	1,050	429	321	400	.....
12						4,160	3,060	999	429	321	400	.....
13						5,780	3,060	999	429	373	400	.....
14						5,900	2,930	926	429	458	400	.....
15						5,210	2,900	891	400	400	400	.....
16						4,260	2,820	838	400	373	400	.....
17						3,770	2,500	804	400	373	400	.....
18						3,500	2,010	738	384	357	400	.....
19						2,500	2,010	660	373	346	400	.....
20						2,290	1,760	624	373	357	400	.....
21						2,740	1,760	587	373	389	400	.....
22						3,960	1,630	587	346	400	400	.....
23						3,960	1,820	587	346	417	400	.....
24						3,960	1,760	554	331	429	400	.....
25						3,960	1,760	554	321	429	400	.....
26						4,320	1,610	520	321	400	400	.....
27						5,210	1,760	624	321	400	400	.....
28						5,580	1,580	624	321	400	.....	.....
29						4,990	1,500	660	373	400	.....	.....
30						4,560	1,500	645	554	400	.....	.....
31						.....	1,430	624	.....	400	.....	.....
1906.												
1				400	738	2,280	2,280	908	738	400	321	400
2				458	520	1,880	2,820	821	738	373	321	400
3				400	908	2,010	3,140	908	660	373	296	400
4				346	908	2,010	3,230	908	660	400	296	400
5				400	1,050	1,520	3,400	954	587	373	296	400
6				373	999	2,900	3,680	1,140	587	373	321	400
7				458	821	2,500	3,400	999	544	429	321	400
8				458	660	2,360	3,400	908	458	373	321	400
9				458	660	2,430	3,400	908	400	321	346	400
10				520	1,150	2,580	3,140	954	400	321	346	400
11				458	1,820	3,230	3,320	908	400	321	373	.....
12				458	2,360	4,160	3,500	821	346	321	373	.....
13				400	2,660	7,380	3,680	738	400	346	373	.....
14				458	3,530	7,500	3,320	821	458	346	346	.....
15				458	2,980	6,260	2,980	738	520	321	346	.....

Daily discharge, in second-feet, of Clark Fork at Fromberg, Mont., for 1905–1910—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.												
16				520	2,540	5,100	2,360	738	520	321	346	
17				458	2,280	4,560	2,080	666	520	296	346	
18				520	1,720	3,580	2,220	660	458	296	321	
19				520	1,520	2,900	2,360	660	458	296	321	
20				554	1,460	2 140	2,220	755	429	273	321	
21				602	2,100	2,010	2,080	2,070	400	273	321	
22				821	2,430	2,140	1,690	1,190	400	273	373	
23				1,240	2,740	2,010	1,630	2,900	400	273	373	
24				1,090	3,320	1,880	1,760	3,230	400	296	373	
25				926	2,900	1,760	1,580	2,900	400	296	373	
26				821	3,400	2,010	1,580	1,520	520	321	346	
27				738	2,900	2,010	1,350	954	520	321	346	
28				738	2,900	2,140	1,300	954	458	321	321	
29				821	2,580	2,140	999	864	458	346	400	
30				738	2,740	2,140	1,090	908	400	321	400	
31					2,580		954	738		321		
1907.												
1			429	400	738	3,400	7,260	3,610	1,340	945	402	375
2			400	446	1,090	5,210	10,000	3,440	1,340	1,040	402	375
3			400	489	1,190	4,880	8,950	3,180	1,180	780	402	375
4			400	489	1,250	3,680	10,300	3,180	1,130	625	402	350
5			400	489	660	4,160	10,700	3,180	1,040	625	402	350
6			373	489	587	5,100	8,660	2,940	1,040	625	375	350
7			373	489	660	6,140	7,620	2,640	1,040	625	375	325
8			373	400	660	6,630	7,180	2,560	1,080	555	375	325
9			373	357	660	5,780	7,330	2,420	1,040	555	375	325
10			346	429	864	5,100	6,890	2,290	1,040	555	375	325
11			346	429	1,190	4,360	6,360	2,040	1,040	555	350	325
12			346	458	1,180	4,260	6,620	2,040	1,040	555	325	325
13			321	520	1,520	4,560	6,100	1,740	1,040	555	325	325
14			321	520	1,410	4,060	5,620	1,560	945	555	325	325
15		458	321	587	1,520	5,100	5,860	1,440	945	522	325	325
16		458	321	660	2,500	5,560	5,620	1,440	860	522	325	325
17		458	346	821	2,660	4,770	4,340	1,440	860	490	430	325
18		458	346	821	3,230	4,460	3,610	1,560	780	490	430	325
19		458	346	587	3,230	4,880	4,240	1,440	780	490	375	325
20		458	346	554	3,680	5,440	4,440	1,380	780	490	375	325
21		458	520	554	3,860	6,140	4,730	1,340	700	490	375	325
22		489	520	520	4,360	6,500	5,160	1,340	700	460	375	325
23		458	520	520	4,460	6,760	5,380	1,230	625	460	375	325
24		458	458	520	3,770	4,990	4,940	1,180	625	460	375	325
25		458	458	587	3,230	4,560	5,620	1,080	555	460	375	325
26		458	458	587	2,820	4,360	5,740	1,130	555	430	375	325
27		458	458	587	1,880	4,770	5,620	1,080	700	430	375	325
28		412	458	587	1,940	5,670	4,340	1,040	700	430	375	325
29			489	554	2,010	8,020	3,880	1,440	1,080	430	375	325
30			489	554	2,140	7,260	3,700	1,380	990	430	375	325
31			489		2,660		3,520	1,340		430		325
1908.												
1			195	275	820	4,530	6,100	2,040	945	555	555	325
2			195	275	945	3,790	5,740	2,040	860	555	555	325
3			195	300	1,440	4,730	6,490	1,920	860	555	555	325
4			195	315	1,560	3,520	6,620	1,920	780	663	555	325
5			275	275	1,440	2,640	8,210	1,920	740	780	555	325
6			275	285	1,560	2,710	6,900	1,800	700	700	522	325
7			275	300	1,980	3,180	5,620	1,800	700	700	522	375
8			275	325	2,710	3,790	4,800	1,800	625	700	522	375
9			275	325	2,940	3,520	4,800	1,800	555	700	522	375
10			300	335	3,100	3,880	5,740	1,560	555	700	522	375
11			325	350	2,290	5,510	5,500	1,340	590	700	490	375
12			325	350	1,620	6,520	5,160	2,040	663	700	490	375
13			325	365	1,500	6,520	4,800	2,160	700	700	490	375
14			325	403	1,390	6,360	4,340	2,100	700	700	490	375
15			325	490	1,280	7,480	4,240	1,620	625	700	490	375
16			325	1,040	1,230	7,170	4,060	1,340	625	700	490	325
17		195	325	1,040	1,130	5,980	3,880	1,340	625	700	490	
18		195	325	750	1,080	5,390	3,520	1,340	663	700	490	
19		195	325	1,040	1,130	3,700	3,520	1,340	663	700	430	
20		195	325	990	1,140	4,150	3,270	1,620	625	700	430	
21		195	325	1,680	2,040	4,940	2,780	1,340	625	625	430	
22		195	325	1,500	1,150	3,270	2,640	1,230	625	625	430	
23		195	325	1,620	1,340	3,520	2,660	1,230	625	625	403	
24		195	325	1,340	1,620	3,360	2,420	1,230	625	625	403	
25		195	300	1,560	1,280	3,360	2,420	1,130	625	555	375	

Daily discharge, in second-feet, of Clark Fork at Fromberg, Mont., for 1905–1910—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
26	.....	195	300	2,160	1,390	3,970	2,290	1,130	555	555	375	.....
27	.....	195	315	860	1,680	3,880	2,360	1,040	555	555	325	.....
28	.....	195	300	820	2,220	3,970	2,290	1,040	555	555	325	.....
29	.....	.....	300	700	2,360	4,150	2,290	860	555	555	325	.....
30	.....	.....	300	700	2,560	5,500	2,160	1,040	555	555	325	.....
31	.....	.....	300	.....	3,880	.....	2,100	945	.....	555	.....	.....
1909.												
1	.....	.....	430	325	350	7,480	1,150	1,560	780	522	300	.....
2	.....	.....	430	325	350	8,810	1,150	1,500	1,680	522	300	.....
3	.....	.....	430	325	490	9,410	12,100	1,560	1,680	522	300	.....
4	.....	.....	430	300	490	10,300	12,100	1,440	1,390	522	300	.....
5	.....	.....	430	275	625	9,710	11,800	1,560	1,080	522	300	.....
6	.....	.....	430	275	625	9,110	10,900	1,340	1,040	522	300	.....
7	.....	.....	430	275	625	8,210	9,860	1,340	1,040	522	300	.....
8	.....	.....	430	275	1,040	7,910	8,060	1,440	1,040	460	300	.....
9	.....	.....	430	300	1,040	7,030	6,900	1,340	990	460	300	.....
10	.....	.....	375	300	1,040	6,620	5,050	1,340	1,130	460	300	.....
11	.....	.....	375	325	625	6,360	4,530	1,340	1,230	460	300	.....
12	.....	.....	375	325	625	5,740	3,880	1,280	1,080	460	300	.....
13	.....	.....	375	325	820	6,230	3,360	1,230	990	460	300	.....
14	.....	.....	375	325	663	5,860	2,780	1,230	900	460	300	.....
15	.....	.....	375	350	740	6,100	2,560	1,340	860	403	300	.....
16	.....	.....	375	375	902	6,230	2,560	1,280	780	403	300	.....
17	.....	.....	375	350	700	7,760	2,500	1,340	740	403	300	.....
18	.....	.....	375	325	590	9,710	2,420	1,340	700	403	300	.....
19	.....	.....	375	325	625	11,200	2,420	1,340	700	403	300	.....
20	.....	.....	375	325	700	10,300	2,420	1,230	700	403	300	.....
21	.....	.....	375	325	945	9,860	2,420	1,230	700	403	300	.....
22	.....	.....	375	325	1,340	8,210	2,420	1,230	663	403	300	.....
23	.....	.....	375	325	2,160	8,210	2,290	1,230	555	403	300	.....
24	.....	.....	375	325	2,940	8,210	2,220	1,130	555	375	300	.....
25	.....	.....	375	325	2,860	8,210	2,100	1,130	555	350	300	.....
26	.....	.....	375	325	3,700	9,110	2,040	1,080	555	350	300	.....
27	.....	.....	375	325	4,440	9,410	1,920	990	555	350	300	.....
28	.....	.....	375	325	4,440	9,860	1,920	945	555	350	300	.....
29	.....	.....	375	325	6,100	10,500	1,620	945	555	350	300	.....
30	.....	.....	325	325	6,760	11,200	1,620	900	555	350	300	.....
31	.....	.....	325	.....	6,760	.....	1,560	820	.....	350	.....	.....
1910.												
1	.....	.....	663	700	1,940	5,980	2,160	945	370	320	370	370
2	.....	.....	625	663	2,160	5,980	2,160	900	370	320	320	400
3	.....	.....	780	625	2,160	5,980	1,940	860	370	320	320	430
4	.....	.....	780	625	2,160	5,980	1,880	860	370	320	320	430
5	.....	.....	740	555	2,560	6,230	1,820	860	320	320	270	430
6	.....	.....	902	555	2,360	5,980	1,800	700	320	320	270	430
7	.....	.....	1,040	490	2,290	6,360	1,800	700	320	320	270	430
8	.....	.....	1,040	490	2,420	6,100	1,500	700	320	320	270	430
9	.....	.....	1,040	490	2,420	5,620	1,440	700	320	320	320	430
10	.....	.....	945	370	2,290	4,940	1,230	490	320	320	320	430
11	.....	.....	900	370	2,560	4,340	1,230	490	320	320	370	320
12	.....	.....	860	370	3,020	4,240	1,130	490	320	320	370	320
13	.....	.....	663	370	3,790	4,150	1,040	490	320	370	320	320
14	.....	.....	520	460	2,860	4,630	1,230	490	320	370	320	320
15	.....	.....	398	490	2,640	4,940	1,230	490	320	370	320	320
16	.....	.....	370	490	2,560	4,730	1,180	490	320	345	320	320
17	.....	.....	370	590	2,560	4,630	1,230	490	320	320	320	295
18	.....	.....	430	700	2,560	3,970	1,040	490	320	320	320	295
19	.....	.....	430	780	2,220	3,880	1,040	460	320	320	320	270
20	.....	.....	430	1,040	2,290	3,790	1,040	430	320	320	320	270
21	.....	.....	430	1,040	2,290	3,880	1,180	430	370	320	320	270
22	.....	.....	490	1,040	2,360	3,700	1,390	430	370	320	320	270
23	.....	.....	490	1,340	2,420	3,440	1,340	460	370	320	320	270
24	.....	.....	490	1,230	2,640	3,440	1,340	490	370	320	320	270
25	.....	.....	555	1,560	2,500	3,440	1,230	490	460	320	320	270
26	.....	.....	625	1,560	2,860	3,360	1,230	430	590	320	320	270
27	.....	.....	625	1,740	3,180	2,940	1,230	430	555	320	320	270
28	.....	.....	590	1,680	3,440	2,780	1,130	430	490	320	320	270
29	.....	.....	625	1,820	3,610	2,500	1,130	430	460	320	370	270
30	.....	.....	700	1,820	4,240	2,220	1,040	430	320	320	430	270
31	.....	.....	700	.....	4,430	.....	990	370	.....	320	.....	270

NOTE.—The daily discharge for 1905 to 1910 are based on rating curves applicable as follows, except as noted: June 3, 1905, to July 5, 1907, well defined between 350 and 6,500 second-feet; July 6, 1907, to Dec. 31, 1910, well defined between 200 and 8,000 second-feet. Ice periods Nov. 28, 1905, to Mar. 31, 1906, Dec. 11, 1906, to Feb. 14, 1907, Jan. 1 to Feb. 16, 1908, Dec. 17, 1908, to Feb. 28, 1909, Dec. 1, 1909, to Feb. 28, 1910.

Monthly discharge of Clark Fork at Fromberg, Mont., for 1905–1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1905.					
June 3–30	6,260	2,290	4,370	243,000	A.
July	4,360	1,430	2,570	158,000	A.
August	1,880	554	927	57,000	A.
September	602	321	418	24,900	A.
October	458	321	378	23,200	A.
Nov. 1–27	458	400	407	21,800	B.
The period				528,000	
1906.					
April	1,240	346	587	54,900	A.
May	3,530	520	1,990	122,000	A.
June	6,260	1,760	2,980	177,000	A.
July	3,680	954	2,450	151,000	A.
August	3,230	660	1,110	68,200	A.
September	738	346	488	29,000	A.
October	429	273	330	20,300	A.
November	400	296	343	20,400	A.
Dec. 1–10			400	7,930	A.
The period				651,000	
1907.					
Feb. 15–28	458	412	455	13,500	C.
March	520	321	405	24,900	C.
April	821	357	533	31,700	B.
May	4,460	587	2,070	127,000	A.
June	8,020	3,400	5,220	311,000	A.
July	10,700	3,520	6,140	378,000	A.
August	3,610	1,040	1,910	117,000	A.
September	1,340	555	919	54,700	A.
October	1,040	430	550	33,800	A.
November	430	325	371	22,100	B.
December	375	325	332	20,400	C.
The period				1,134,000	
1908.					
Feb. 17–28	195	195	195	4,640	C.
March	325	195	294	18,100	B.
April	2,160	275	758	45,100	A.
May	3,880	820	1,730	106,000	A.
June	7,480	2,640	4,500	268,000	A.
July	8,210	2,100	4,180	257,000	A.
August	2,160	860	1,520	93,500	A.
September	945	555	656	39,000	A.
October	780	555	645	39,700	A.
November	555	325	462	27,500	B.
Dec. 1–16	375	325	353	11,200	C.
The period				909,740	
1909.					
March	430	325	359	22,100	A.
April	375	275	319	19,000	A.
May	6,760	350	1,810	111,000	A.
June	11,200	5,740	8,430	502,000	A.
July	12,100	1,560	4,880	300,000	A.
August	1,560	820	1,260	77,500	A.
September	1,680	555	878	52,200	A.
October	522	350	430	26,400	A.
November	300	300	300	17,900	B.
The period				1,130,000	
1910.					
January			[a] 300	18,400	
February			[a] 350	19,400	
March	1,040	370	653	40,200	B.
April	1,820	370	868	51,600	A.
May	4,430	1,940	2,700	166,000	A.
June	6,360	2,220	4,470	266,000	A.
July	2,160	990	1,370	84,200	B.
August	945	370	560	34,400	A.
September	590	320	365	21,700	A.
October	370	320	326	20,000	A.
November	430	270	324	19,300	A.
December	430	270	330	20,300	B.
The year			1,050	762,000	

[a] Discharge estimated Jan. 1 to Feb. 28. The means are approximate.

PRYOR CREEK BASIN.

PRYOR CREEK AT HUNTLEY, MONT.

Pryor Creek rises in the Pryor Mountains in southern Carbon County, Mont., flows northeastward, and enters Yellowstone River from the south about 15 miles northeast of Billings.

The gaging station was originally established August 6, 1904, to determine the amount of water available for irrigation. On June 15–16, 1906, the creek was turned into a new channel by the United States Reclamation Service, and a station was established on the steel highway bridge crossing this channel one-half mile from the railroad station at Huntley. Since then the chain-gage datum has not been changed. Measurements are made from this bridge.

The channel is straight with uniform slope for 800 feet above and below the station. The banks are steep and uniformly graded, are clean, and will not overflow. The current is moderate. The bed is composed of clay and gravel and may change somewhat. On the upper portion of the stream some water is diverted for irrigation.

The stream freezes over during the winter months. Results obtained are good.

Discharge measurements of Pryor Creek at Huntley, Mont., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 10	W. A. Lamb	30	56	1.72	74
June 3	Raymond Richards	29	56	1.63	57
July 18	do	27	44	1.13	16
Aug. 10[a]	W. A. Lamb	8	3.5	1.05	7.7
24	do	30	15	1.13	13
Nov. 13	do	28	50	1.43	41

[a] Made by wading below canal crossing.

Daily gage height, in feet, of Pryor Creek at Huntley, Mont., for 1910.

[Arthur Foster, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.6	1.5	1.8	1.5	1.0	1.2	1.7	1.4	1.45
2		1.6	1.5	1.7	1.3	1.05	1.8	1.6	1.4	1.5
3		1.6	1.5	1.65	1.3	1.0	2.4	1.6	1.45	1.5
4		1.6	1.5	1.65	1.3	1.0	1.7	1.5	1.45	1.5
5		1.6	1.5	1.6	1.3	1.0	1.2	1.45	1.4	1.5
6		1.6	1.6	1.5	1.3	1.0	1.2	1.45	1.5	1.5
7		1.6	1.65	1.5	1.2	1.0	1.2	1.4	1.5	1.5
8		1.6	2.4	1.5	1.2	1.0	1.2	1.4	1.5	1.5
9		1.6	1.5	1.5	1.3		1.2	1.4	1.5	1.5
10		1.6	1.8	1.5	1.2	1.05	1.2	1.4	1.5	1.5
11	2.05	1.6	1.6	1.5	1.2	1.05	1.2	1.4	1.5	1.5
12	2.05	1.6	1.6	1.5	1.15	1.0	1.35	1.4	1.5	1.5
13	2.0	1.65	1.6	1.5	1.15	1.0	1.3	1.4	1.42	1.6
14	1.95	1.8	1.7	1.5	1.15	1.0	1.2	1.4	1.42	1.5
15	1.9	1.8	1.7	1.7	1.15	1.2	1.2	1.4	1.4	1.5

Daily gage height, in feet, of Pryor Creek at Huntley, Mont., for 1910—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	1.9	1.7	2.4	1.4	1.15	1.1	1.2	1.4	1.4	1.5
17	1.8	1.7	3.0	1.4	1.15	1.1	1.1	1.6	1.4	1.5
18	1.8	1.7	3.5	1.3	1.1	1.1	1.1	1.7	1.5	1.5
19	1.8	1.6	2.9	1.3	1.1	1.1	1.2	1.4	1.7	1.5
20	1.8	1.6	2.6	1.3	1.1	1.1	1.2	1.4	1.5	1.5
21	1.8	1.6	2.1	1.3	1.1	1.1	1.3	1.4	1.45	1.5
22	1.8	1.6	2.1	1.3	1.1	1.1	1.3	1.4	1.45	1.5
23	1.9	1.6	2.0	1.25	1.1	1.1	1.3	1.4	1.48	1.5
24	1.9	1.6	2.0	1.2	1.1	1.1	1.4	1.4	1.48	1.5
25	1.9	1.5	2.0	1.2	1.05	1.1	1.45	1.35	1.5	1.5
26	1.9	1.5	2.0	1.2	1.05	1.0	1.5	1.45	1.5	1.48
27	1.9	1.5	2.0	1.2	1.0	1.0	3.1	1.4	1.48	1.48
28	1.75	1.5	1.95	1.2	.9	1.0	2.7	1.4	1.45	1.45
29	1.7	1.5	1.9	1.6	.9	1.0	2.4	1.4	1.4	1.45
30	1.7	1.5	1.9	1.5	.9	1.25	2.4	1.4	1.42	1.45
31	1.7	.....	1.85	.....	.9	1.2	.....	1.4	.....	1.4

NOTE.—Probably affected by ice during greater part of January and February.

Daily discharge, in second-feet, of Pryor Creek at Huntley, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	58	48	79	48	5	20	68	38	43
2	.....	58	48	68	29	8.5	79	58	38	48
3	.....	58	48	63	29	5	156	58	43	48
4	.....	58	48	63	29	5	68	48	43	48
5	.....	58	48	58	29	5	20	43	38	48
6	.....	58	58	48	29	5	20	43	48	48
7	.....	58	63	48	20	5	20	38	48	48
8	.....	58	156	48	20	5	20	38	48	48
9	.....	58	48	48	29	[a] 6.8	20	38	48	48
10	.....	58	79	48	20	8.5	20	38	48	48
11	109	58	58	48	20	8.5	20	38	48	48
12	109	58	58	48	16	5	34	38	48	48
13	103	63	58	48	16	5	29	38	40	58
14	97	79	68	48	16	5	20	38	40	48
15	91	79	68	68	16	20	20	38	38	48
16	91	68	156	38	16	12	20	38	38	48
17	79	68	240	38	16	12	12	58	38	48
18	79	68	318	29	12	12	12	68	48	48
19	79	58	226	29	12	12	20	38	68	48
20	79	58	184	29	12	12	20	38	48	48
21	79	58	115	29	12	12	29	38	43	48
22	79	58	115	29	12	12	29	38	43	48
23	91	58	103	24	12	12	29	38	46	48
24	91	58	103	20	12	12	38	38	46	48
25	91	48	103	20	8.5	12	43	34	48	48
26	91	48	103	20	8.5	5	48	43	48	46
27	91	48	103	20	5	5	254	38	46	46
28	74	48	97	20	1	5	198	38	43	43
29	68	48	91	58	1	5	156	38	38	43
30	68	48	91	48	1	24	156	38	40	43
31	68	.....	85	.....	1	20	.....	38	.....	38

[a] Discharge interpolated.

NOTE.—These discharges are based on a rating curve that is fairly well defined.

Monthly discharge of Pryor Creek at Huntley, Mont., for 1910.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	[a] 25	0.031	0.04	1,540	
February	.....	.....	[a] 30	.038	.04	1,670	
March	109	40	[a] 84.1	.105	.12	5,170	C.
April	79	48	58.6	.073	.08	3,490	A.
May	318	48	103	.129	.15	6,330	A.
June	79	20	42.7	.053	.06	2,540	A.
July	48	1	16.4	.020	.02	1,010	B.
August	24	5	9.24	.012	.01	568	B
September	254	12	54.3	.068	.08	3,230	A.
October	68	34	42.5	.053	.06	2,610	A.
November	68	38	44.5	.055	.06	2,650	A.
December	58	38	47.2	.059	.07	2,900	B.
The year	318	1	42.1	.058	.79	33,100	

[a] Discharge estimated Jan. 1 to Mar. 10.

NOTE.—The means for January and February are only approximate.

BIGHORN RIVER BASIN.

DESCRIPTION.

Bighorn River is formed by the junction of Big and Little Wind rivers near Riverton, Wyo.

Big Wind River rises some 50 miles southeast of the Yellowstone National Park in the mountains of the Shoshone and Wind River ranges, whose highest peaks attain altitudes of more than 12,000 feet, and flows in a general southeasterly direction for about 100 miles to its mouth, where the elevation is 5,100 feet. The upper part of its basin is hilly and mountainous except along the river and its tributaries, where the bottom lands average a mile or so in width. About 40 miles above Riverton the valley broadens out and includes stretches of land several miles in width excellently adapted to agriculture. The most important tributary of Big Wind River is Bull Lake Creek; among other tributaries may be mentioned Red, Dinwoody, Dry, Willow, and Meadow creeks.

Little Wind River rises on the eastern side of the Wind River Range and flows eastward for about 50 miles to its confluence with Big Wind River. At the junction of the North and South forks of the Little Wind, near Fort Washakie, the valleys of these streams widen out into an excellent agricultural section. Above Fort Washakie the drainage area is generally hilly and mountainous in character.

The principal tributary of Little Wind River is the Popo Agie, which rises in the high mountains and flows northeastward to its confluence with the Little Wind River at Arapahoe, Wyo., and which emerges from the mountains about 8 miles above Lander, Wyo.

This stream at its mouth is considerably larger than Little Wind River. Important tributaries of the Popo Agie are the North Fork, which enters just below Lander, and the Little Popo Agie, which comes in at Hudson, about 10 miles below Lander. The valleys of the Popo Agie and its tributaries are comparatively wide and form one of the oldest irrigated sections of Wyoming. Among the other tributaries of Little Wind River are St. Lawrence, Sage, and Trout creeks.

From Riverton, Wyo., to its junction with the Yellowstone near Bighorn, Mont., a distance of about 250 miles, the Bighorn flows northward. At Thermopolis, 55 miles below Riverton, the elevation is about 4,200 feet; at the mouth of the Shoshone, 90 miles below Thermopolis, it is 3,800 feet; and at the mouth of the Bighorn it is about 2,700 feet.

Owl Creek, No Wood River, Greybull River, Shell Creek, Shoshone River, and Little Bighorn River are important tributaries of the Bighorn. The drainage area of Bighorn River above the mouth of the Shoshone is about 15,500 square miles.

The mountainous area drained by the Bighorn and its tributaries contains several hundred square miles of timber land, a great part of which is included in national forests. The remainder of the area, with the exception of occasional strips of land under cultivation, may be classed as range and sagebrush land.

The rainfall seems to range from 20 inches or more above an altitude of 9,000 feet to an average of 12 to 15 inches at elevations from 4,000 to 7,000 feet. Below an altitude of 4,000 feet the rainfall is locally less than 12 inches.

The winters on the upper Bighorn above an altitude of 4,500 feet are severe. Snowfall is abundant in the high mountains, and heavy snowstorms also take place in the more open country, but in the plains section the snow does not usually remain for long periods. As compared with those in the upper basin, the winters in what is called the Bighorn Basin are mild. This basin begins where the river emerges from the canyon above Thermopolis and extends nearly to the mouth of the river. Most of the lower drainage area of Shoshone River is included in this basin. This belt is subject to the influence of the so-called chinook winds. Nearer the mouth of the stream the winters are more severe.

Irrigation along Bighorn River is developing very rapidly. For a number of years irrigation has been practiced in comparatively restricted tracts at various points along the stream and its tributaries, as in the Lander and Thermopolis districts in Wyoming, and in the Crow Reservation in Montana, as well as on the No Wood, Greybull, Shoshone, and other tributaries; but such irrigation has used only a small part of the total flow of these streams. Extensive

irrigation works now being constructed by the Indian Office on the Shoshone Reservation in Wyoming and the Crow Reservation in Montana will eventually serve probably 225,000 acres; the Shoshone project of the United States Reclamation Service will provide for the irrigation of more than 125,000 acres along Shoshone River; by using some of the storage sites on Big Wind River the Wyoming Central Irrigation Co. will irrigate several hundred thousand acres of land near Riverton, and other private enterprises will irrigate considerable land near Basin. Many opportunities for additional projects are to be found on the tributary streams.

As a large part of the drainage area of Bighorn River has never been carefully surveyed, the amount of practicable storage is not well known, but undoubtedly many excellent reservoir sites exist at the headwaters of Big Wind and Little Wind rivers. Among others may be mentioned the site on Bull Lake Creek, which is situated at a natural lake on this stream, and many similar lakes are to be found in that locality. It is believed that good sites can be found for storing the flood waters of Paint Rock, Owl Creek, Shell Creek, and Greybull River. Many of these streams have a large annual run-off, but some of them are intermittent in character.

Probably the best reservoir site in the area is the one which the Reclamation Service is now developing on Shoshone River 8 miles above Cody, Wyo. With a dam 310 feet high above foundation the reservoir will have a capacity of 456,000 acre-feet.

The value of the land along the Bighorn River and its tributaries for agriculture will probably restrict water-power development to streams of the headwater regions. The fall of many of these streams exceeds 300 feet to the mile. Popo Agie and Little Wind rivers probably afford the best opportunities. In the canyon of the Bighorn above Thermopolis, where the Big Horn Company is now constructing a plant with a capacity of about 5,000 horsepower, at least 25,000 horsepower can be developed. Of the 100,000 horsepower or more which might easily be developed, probably less than 1,000 horsepower are now being utilized.

BIGHORN RIVER NEAR THERMOPOLIS, WYO.

This station, which is located on the county highway bridge between Thermopolis and the Thermopolis Hot Springs, was established May 28, 1900, discontinued December 31, 1905, and reestablished June 30, 1910. The principal tributaries above the station are Wind, Little Wind, Popo Agie, and Badwater rivers. Below the station No Wood, Greybull, Shoshone, and Little Bighorn rivers are the important tributaries.

The drainage area above the station is 8,180 square miles.

A staff gage is fastened securely to the downstream side of the middle pier of the bridge. The gage datum has remained constant. Discharge measurements are made from the highway bridge.

The bed of the stream is composed of rock and gravel and is practically permanent. The discharge at this station is little affected by ice.

Irrigation is carried on extensively on the tributaries of Bighorn, but not from the river itself.

Discharge measurements of Bighorn River near Thermopolis, Wyo., in 1910.

Date	Hydrographer	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 30	J. C. Beebe.	240	744	2.44	2,320
Aug. 23	do	216	557	1.70	1,240
Sept. 25	do	219	585	1.95	1,600

Daily gage height, in feet, and discharge, in second-feet, of Bighorn River near Thermopolis, Wyo., for 1910.

[Victor T Johnson, observer.]

Day.	July.		Aug.		Sept.		Oct.		Nov.		Dec.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge
1			3.0	3,300	1.5	1,020	1.3	830	1.3	830	1.0	580
2			2.6	2,580	1.5	1,020	1.42	940	1.3	830	1.1	660
3			2.3	2,080	.....	995	1.4	920	1.3	830	1.1	660
4			2.4	2,240	.....	970	1.3	830	1.3	830	1.1	660
5			2.5	2,410	.....	945	1.3	830	1.3	830	1.1	660
6			2.4	2,240	1.4	920	1.2	740	1.2	740	1.1	660
7			2.3	2,080	1.3	830	1.2	740	1.2	740	1.1	660
8			2.2	1,930	1.3	830	1.2	740	1.2	740	1.1	660
9			2.3	2,080	1.2	740	1.2	740	1.1	660	1.1	660
10			2.0	1,650	1.2	740	1.2	740	1.1	660	1.1	660
11			2.1	1,790	1.2	740	1.2	740	1.1	660	1.1	660
12			2.1	1,790	1.2	740	1.2	740	1.1	660	1.1	660
13			2.0	1,650	1.2	740	1.2	740	1.1	660	1.1	660
14			2.0	1,650	1.2	740	1.2	740	1.1	660	1.1	660
15			2.0	1,650	1.2	740	1.2	740	1.1	660	1.1	660
16			1.7	1,250	1.2	740	1.2	740	1.1	660	1.1	660
17			1.8	1,380	1.2	740	1.3	830	1.1	660	1.0	580
18			1.8	1,380	1.2	740	1.3	830	1.0	580	1.0	580
19			1.8	1,380	1.2	740	1.3	830	1.0	580	1.0	580
20			1.7	1,250	1.2	740	1.3	830	1.0	580	1.0	580
21			1.7	1,250	1.2	740	1.3	830	1.0	580	.9	510
22			1.7	1,250	1.6	1,130	1.3	830	1.0	580	.9	510
23			1.7	1,250	2.1	1,790	1.3	830	1.0	580	.9	510
24			1.7	1,250	2.0	1,650	1.3	830	1.1	660	.9	510
25			1.7	1,250	1.9	1,510	1.3	830	1.1	660	.9	510
26			1.7	1,250	1.7	1,250	1.3	830	1.1	660	.9	510
27			1.7	1,250	1.6	1,130	1.3	830	1.1	660	.9	510
28			1.7	1,250	1.5	1,020	1.3	830	1.0	580	.9	510
29			1.6	1,130	1.5	1,020	1.3	830	1.0	580	.9	510
30	2.45	2,320	1.5	1,020	1.4	920	1.3	830	1.0	580	.9	510
31	2.6	2,580	1.5	1,020	.....	.....	1.3	830	.....	.....	9	510

NOTE.—These discharges are based on a rating curve that is well defined between 920 and 3,300 second-feet. Discharges interpolated Sept. 3 to 5.

Monthly discharge of Bighorn River near Thermopolis, Wyo., for 1910.

[Drainage area, 8,180 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
August	3,300	1,020	1,640	0.200	0.23	101,000	A.
September	1,790	740	952	.116	.13	56,600	A.
October	940	740	805	.098	.11	49,500	B.
November	830	580	672	.082	.09	40,000	B.
December	660	510	594	.073	.08	36,500	B.

BIGHORN RIVER NEAR HARDIN, MONT.[1]

This station, which was established June 16, 1904, to determine the amount of water available for irrigation, is located at the bridge of the Burlington & Missouri River Railroad about half a mile above the junction of Bighorn and Little Bighorn rivers, and 2 miles from Hardin. Water is diverted a few miles above the station by a private irrigation company to irrigate land on the west side of the river.

The river freezes over during the winter months.

The present gage datum is 3 feet higher than that of the original chain gage; but on August 10, 1905, the gage was moved to the west span of the bridge and the datum lowered 2 feet. Gaging conditions at this station are good. The bed of the stream is of gravel, and is free from vegetation. All measurements are made from this railroad bridge.

Discharge measurements of Bighorn River near Hardin, Mont., for 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 17	Raymond Richards	437	2,260	4.22	4,890
Aug. 28	J. C. Beebe	427	1,870	3.33	2,480
Nov. 12	W. A. Lamb	288	1,460	3.03	1,510

Daily gage height, in feet, of Bighorn River near Hardin, Mont., for 1910.

[E. P. Sweeney, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.3	5.5	5.5	5.0		3.2	3.05	2.9	3.1
2		3.3	5.3	5.7	4.9		3.2	3.05	2.9	3.1
3		3.3	5.0	6.0	4.9		3.2	3.05	2.9	3.1
4		3.3	4.8	6.0	4.8		3.2	3.05	2.9	3.1
5		3.3	4.8	6.0	4.7		3.2	3.25	2.9	3.1
6		3.3	5.0	5.9	4.6		3.4	3.15	2.9	3.0
7		3.3	5.5	5.7	4.5		3.3	3.15	2.9	3.0
8	4.9	3.3	5.5	5.5	4.5		3.2	3.05	3.0	3.0
9	4.9	3.3	5.4	5.4	4.5		3.1	3.05	3.0	3.0
10	4.8	3.4	5.3	5.3	4.5		3.1	3.05	3.1	3.0

[1] Referred to as at "Fort Custer" in Water-Supply Paper, No. 208, p. 96.

Daily gage height, in feet, of Bighorn River near Hardin, Mont., for 1910—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	4.7	3.5	5.5	5.2	4.5	.....	3.1	2.95	3.1	.....
12	4.6	3.6	5.9	5.2	4.4	.....	3.0	2.95	3.0	.....
13	4.3	3.7	6.0	5.1	4.4	.....	3.0	2.85	3.0	.....
14	4.0	3.8	6.1	5.0	4.3	3.8	2.9	2.85	3.0	.....
15	3.9	3.9	6.0	5.5	4.3	3.8	2.9	2.85	3.0	.....
16	3.8	4.0	5.9	5.6	4.2	3.8	2.9	2.85	3.0	.....
17	3.7	4.0	5.6	5.4	4.2	3.8	2.75	2.8	2.9	.....
18	3.6	3.9	5.4	5.6	4.2	3.7	2.75	2.8	2.9	.....
19	3.5	3.8	5.3	5.5	4.2	3.7	2.75	2.8	2.9	.....
20	3.6	4.0	5.2	5.4	4.3	3.6	2.85	2.8	2.9	.....
21	3.65	4.1	5.1	5.2	4.4	3.6	2.85	2.8	2.9	.....
22	3.6	4.2	5.1	5.1	4.5	3.5	2.95	2.8	3.05	.....
23	3.6	4.2	5.1	5.0	4.6	3.5	3.25	2.8	3.05	.....
24	3.6	4.5	5.1	5.2	4.6	3.4	3.55	2.8	3.0	.....
25	3.6	4.6	5.1	5.0	4.5	3.3	3.55	2.8	3.0	.....
26	3.6	4.8	5.1	5.0	4.4	3.2	3.55	2.9	3.0	.....
27	3.6	4.9	5.4	4.9	4.4	3.1	3.35	2.9	3.15	.....
28	3.5	5.0	5.7	4.8	4.3	3.2	3.25	2.9	3.0	.....
29	3.5	5.2	5.5	4.7	4.2	3.3	3.15	2.9	3.0	.....
30	3.4	5.7	5.4	4.7	4.2	3.3	3.05	2.9	3.0	.....
31	3.4	.....	5.3	.....	.....	3.2	.....	2.9	.....	.....

Daily discharge, in second-feet, of Bighorn River near Hardin, Mont., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2,440	9,360	9,360	7,410	.....	2,220	1,910	1,620	2,010
2	.....	2,440	8,550	10,200	7,050	.....	2,220	1,910	1,620	2,010
3	.....	2,440	7,410	11,600	7,050	.....	2,220	1,910	1,620	2,010
4	.....	2,440	6,700	11,600	6,700	.....	2,220	1,910	1,620	2,010
5	.....	2,440	6,700	11,600	6,360	.....	2,220	2,330	1,620	2,010
6	.....	2,440	7,410	11,100	6,030	.....	2,670	2,110	1,620	1,810
7	.....	2,440	9,360	10,200	5,710	.....	2,440	2,110	1,620	1,810
8	7,050	2,440	9,360	9,360	5,710	.....	2,220	1,910	1,810	1,810
9	7,050	2,440	8,950	8,950	5,710	.....	2,010	1,910	1,810	1,810
10	6,700	2,670	8,550	8,550	5,710	.....	2,010	1,910	2,010	1,810
11	6,360	2,910	9,360	8,160	5,710	.....	2,010	1,720	2,010	.....
12	6,030	3,160	11,100	8,160	5,400	.....	1,810	1,720	1,810	.....
13	5,100	3,420	11,600	7,780	5,400	.....	1,810	1,530	1,810	.....
14	4,230	3,680	12,000	7,410	5,100	3,680	1,620	1,530	1,810	.....
15	3,950	3,950	11,600	9,360	5,100	3,680	1,620	1,530	1,810	.....
16	3,680	4,230	11,100	9,780	4,800	3,680	1,620	1,530	1,810	.....
17	3,420	4,230	9,780	8,950	4,800	3,680	1,350	1,440	1,620	.....
18	3,160	3,950	8,950	9,780	4,800	3,420	1,350	1,440	1,620	.....
19	2,910	3,680	8,550	9,360	4,800	3,420	1,350	1,440	1,620	.....
20	3,160	4,230	8,160	8,950	5,100	3,160	1,530	1,440	1,620	.....
21	3,290	4,510	7,780	8,160	5,400	3,160	1,530	1,440	1,620	.....
22	3,160	4,800	7,780	7,780	5,710	2,910	1,720	1,440	1,910	.....
23	3,160	4,800	7,780	7,410	6,030	2,910	2,330	1,440	1,910	.....
24	3,160	5,710	7,780	8,160	6,030	2,670	3,040	1,440	1,810	.....
25	3,160	6,030	7,780	7,410	5,710	2,440	3,040	1,440	1,810	.....
26	3,160	6,700	7,780	7,410	5,400	2,220	3,040	1,620	1,810	.....
27	3,160	7,050	8,950	7,050	5,400	2,010	2,560	1,620	2,110	.....
28	2,910	7,410	10,200	6,700	5,100	2,220	2,330	1,620	1,810	.....
29	2,910	8,160	9,360	6,360	4,800	2,440	2,110	1,620	1,810	.....
30	2,670	10,200	8,950	6,360	4,800	2,440	1,910	1,620	1,810	.....
31	2,670	.....	8,550	.....	.....	2,220	.....	1,620	.....	.....

NOTE.—These discharges are based on a fairly well defined rating curve.

Monthly discharge of Bighorn River near Hardin, Mont., for 1910.

[Drainage area, 20,700 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January			1,700	0.082	0.09	104,000	D.
February			1,800	.087	.09	100.000	D.
March			4,200	.203	.24	258,000	C.
April	10,200	2,440	4,250	.205	.23	253,000	B.
May	12,000	6,700	8,940	.432	.50	550,000	B.
June	11,600	6,360	8,770	.424	.47	522,000	B.
July	7,410	4,800	5,630	.272	.31	346,000	B.
August			3,450	.167	.19	212,000	C.
September	3,040	1,350	2,070	.100	.11	123,000	B.
October	2,330	1,440	1,680	.081	.09	103,000	B.
November	2,110	1,620	1,760	.085	.10	105,000	B.
December			1,650	.080	.09	101,000	D.
The year			3,820	.185	2.51	2,780,000	

NOTE.—Means for January and February estimated; mean for period Mar. 1–7 estimated at 4,860 second-feet; mean for period Aug. 1–13 estimated at 4,210 second-feet; mean for period Dec. 11–31 estimated at 1,530 second-feet.

OWL CREEK NEAR THERMOPOLIS, WYO.

Owl Creek rises in the Owl Creek Mountains in western Wyoming, and flows eastward to its union with Bighorn River just below Thermopolis. Below the junction of its north and south forks it receives several small tributaries.

Irrigation is practiced quite extensively on this stream and the low-water flow is practically all appropriated. On the upper portions of the stream some good reservoir sites exist.

The gaging station was established July 30, 1910, on a newly constructed highway bridge, about 5 miles northwest of Thermopolis, Wyo., near the ranch buildings of the observer, C. H. McCumber.

The gage is an ordinary staff fastened to the upstream side of the bridge. Discharge measurements are made by wading. The channel will probably shift.

Discharge measurements of Owl Creek near Thermopolis, Wyo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 30	Raymond Richards	16	7	1.69	7.4
Aug. 23	J. C. Beebe			1.25	[a] 2
Sept. 27	do	13	11	1.81	8.9

[a] Estimated.

NOTE.—All measurements made by wading at various sections.

Daily gage height, in feet, and discharge, in second-feet, of Owl Creek near Thermopolis, Wyo., for 1910.

[C. H. McCumber, observer.]

Day.	July.		Aug.		Sept.		Oct.		Nov.		Dec.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			1.8	9.3	1.4	1.7	1.6	4.9	1.7	7	1.7	7
2			1.5	3.1	1.4	1.7	1.7	7	1.7	7	1.7	7
3			1.5	3.1	1.4	1.7	1.7	7	1.7	7	1.7	7
4			1.4	1.7	1.4	1.7	1.7	7	1.7	7	1.7	7
5			1.4	1.7	1.4	1.7	1.7	7	1.7	7	1.7	7
6			1.4	1.7	1.5	3.1	1.7	7	1.7	7	.....	(a)
7			1.4	1.7	1.5	3.1	1.7	7	1.7	7	.....	.....
8			1.4	1.7	1.7	7	1.7	7	1.7	7	.....	.....
9			1.4	1.7	1.7	7	1.6	4.9	1.7	7	.....	.....
10			1.4	1.7	1.7	7	1.55	4.0	1.7	7	.....	.....
11			1.4	1.7	1.7	7	1.5	3.1	1.7	7	.....	.....
12			1.4	1.7	1.7	7	1.5	3.1	1.7	7	.....	.....
13			1.4	1.7	1.7	7	1.5	3.1	1.7	7	.....	.....
14			1.4	1.7	1.7	7	1.5	3.1	1.7	7	.....	.....
15			1.4	1.7	1.7	7	1.5	3.1	1.7	7	.....	.....
16			1.4	1.7	1.5	3.1	1.5	3.1	1.7	7	.....	.....
17			1.4	1.7	1.5	3.1	1.5	3.1	1.7	7	.....	.....
18			1.3	.6	1.5	3.1	1.5	3.1	1.7	7	.....	.....
19			1.3	.6	1.5	3.1	1.5	3.1	1.7	7	.....	.....
20			1.3	.6	1.5	3.1	1.5	3.1	1.7	7	.....	.....
21			1.3	.6	1.5	3.1	1.5	3.1	1.7	7	.....	.....
22			1.3	.6	2.75	34	1.5	3.1	1.7	7	.....	.....
23			1.3	.6	2.4	25	1.5	3.1	1.7	7	.....	.....
24			1.3	.6	3.0	40	1.5	3.1	1.7	7	.....	.....
25			1.3	.6	2.7	33	1.5	3.1	1.7	7	.....	.....
26			1.3	.6	1.8	9.3	1.5	3.1	1.7	7	.....	.....
27			1.3	.6	1.7	7	1.7	7	1.7	7	.....	.....
28			1.3	.6	1.7	7	1.7	7	1.7	7	.....	.....
29			1.3	.6	1.6	4.9	1.7	7	1.7	7	.....	.....
30	1.7	7	1.3	.6	1.6	4.9	1.7	7	1.7	7	.....	.....
31	2.1	17	1.3	.6	.....	.....	1.7	7	.....	.....	.....	.....

a Ice probably existed Dec. 6 to 31.

NOTE.—These discharges are based on a curve that is fairly well defined.

Monthly discharge of Owl Creek near Thermopolis, Wyo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
August	9.3	0.6	1.54	95	B.
September	40	1.7	8.48	505	B.
October	7	3.1	2.32	143	B.
November	7	7	7.0	417	C.
Dec. 1–5	.....	.....	7.0	69	D.

NO WOOD RIVER BASIN.

DESCRIPTION.

No Wood River rises in the Bighorn Mountains and flows northwestward to its junction with Bighorn River near Manderson, Wyo.

The principal tributaries of the No Wood are Otter Creek, Tensleep Creek, and Paint Rock Creek.

The irrigable land along the No Wood bottom is so narrow that irrigation can not be extensively practiced. Along the benches to

the north and west, however, there is considerable land which will eventually be irrigated. At present there is a project to take water from Tensleep Creek and irrigate the benches between that stream and Paint Rock Creek, and another project to carry water from the Paint Rock Creek to the benches between No Wood River and Shell Creek. In the mountains there are several good dam sites which will be used in storing the flood waters for these and other irrigation projects.

NO WOOD RIVER AT BONANZA, WYO.

This station was established July 29, 1910, near the ranch of J. W. Graves, one-fourth mile north of Bonanza post office, Wyo., in T. 49 N., R. 91 E. Discharge measurements are made by wading 50 feet below the gage. During floods, measurements are made from a highway bridge one-half mile below. The winter discharge is affected by ice. On August 29 a chain gage was installed on the left bank near the public highway, some 30 feet above the temporary staff gage at the same datum.

Paint Rock Creek enters the No Wood 1 mile above the station, Tensleep Creek about 20 miles above, and Otter Creek 35 miles above.

Irrigation is carried on to some extent and diversions are made both above and below the station.

Discharge measurements of No Wood River at Bonanza, Wyo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 29	Richards and Beebe	85	60	1.92	64
Aug. 26[a]	J. C. Beebe	108	180	1.91	72
Sept. 19	do	80	158	2.30	151
23	do	88	185	2.59	248
24	do	84	183	2.54	234

[a] Made from bridge about one-half mile below gage.

NOTE.—All measurements except that of Aug. 26 were made by wading.

Daily gage height, in feet, and discharge, in second-feet, of No Wood River at Bonanza, Wyo., for 1910.

[J. W. Graves, observer.]

Day.	July.		Aug.		Sept.		Oct.		Nov.		Dec.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1	.....	.....	2.20	125	1.90	63	2.45	198	2.48	208	2.38	.....
2	.....	.....	2.10	101	1.95	72	2.45	198	.....	207	2.38	.....
3	.....	.....	2.10	101	1.95	72	2.45	198	.....	206	2.40	.....
4	.....	.....	2.10	101	2.00	80	2.75	302	.....	205	2.38	.....
5	.....	.....	2.10	101	2.20	125	2.69	280	.....	204	2.38	.....
6	.....	.....	2.10	101	2.15	113	2.58	241	.....	203	1.98	.....
7	.....	.....	2.00	80	2.05	90	2.56	234	.....	202	2.80	.....
8	.....	.....	1.90	63	2.10	101	2.55	231	.....	200	.....	.....
9	.....	.....	1.90	63	2.10	101	2.54	228	2.45	198	.....	.....
10	.....	.....	1.90	63	2.10	101	2.53	224	2.45	198	.....	.....

Daily gage height, in feet, and discharge, in second-feet, of No Wood River, at Bonanza, Wyo., for 1910—Continued.

Day.	July.		Aug.		Sept.		Oct.		Nov.		Dec.	
	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-ch'ge.
11			1.95	72	2.10	101	2.50	214	2.45	198		
12			1.95	72	2.15	113	2.50	214	2.44	195		
13			1.90	63	2.20	125	2.52	221	2.44	195		
14			1.90	63	2.20	125	2.50	214	2.44	195		
15			2.00	80	2.25	138	2.46	201	2.42	188		
16			1.95	72	2.25	138	2.45	198	2.40	182		
17			1.90	63	2.25	138	2.46	201	2.32	258		
18			1.90	63	2.30	152	2.50	214	2.30	152		
19			1.90	63	2.35	167	2.50	214	2.38	176		
20			1.90	63	2.30	152	2.50	214	2.48	208		
21			1.90	63	2.30	152	2.49	211	2.28	247		
22			1.90	63	2.65	266	2.48	207	2.44	195		
23			1.90	63	2.65	266	2.48	207	2.42	188		
24			1.85	56	2.60	248	2.46	201	2.42	188		
25			1.90	63	2.60	248	2.46	201	2.40	182		
26			1.90	63	2.57	238	2.45	198	2.40	182		
27			1.90	63	2.55	231	2.45	198	2.26	141		
28			1.90	63	2.52	221	2.45	198	2.51	140		
29	1.90	63	1.90	63	2.50	214	2.43	192	2.46	140		
30	1.90	63	1.90	63	2.46	201	2.42	288	2.34	140		
31	2.30	152	1.90	63			2.48	208				

NOTE.—These discharges are based on a rating curve fairly well defined. Ice conditions Nov. 27 to Dec. 31. Discharges interpolated Nov. 2 to 8.

Monthly discharge of No Wood River at Bonanza, Wyo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
August	125	63	73	4,490	B.
September	248	63	152	9,040	B.
October	302	192	218	13,400	B.
November	258	140	191	11,400	B.

TENSLEEP CREEK NEAR TENSLEEP, WYO.

This station was established September 21, 1910, on Burke's ranch, 5 miles from Tensleep post office. The gage is 800 feet east of the county bridge near a cliff 80 feet high on north side of creek. Canyon Fork, the principal tributary, enters the stream just above the station.

An inclined and upright staff gage is used. At low and ordinary stages discharge measurements are made by wading; at flood stages measurements are made from the bridges over Canyon Fork and Tensleep Creek.

The bed of the creek is a rocky ledge.

Ice will probably occur in extreme cold weather.

A small amount of irrigation is practiced on this stream.

Discharge measurements of Tensleep Creek near Tensleep, Wyo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Sept. 22[a]	J. C. Beebe	59	59	0.42	93
Do.[b]	do			.40	[c] 87
Sept. 23[b]	do			.61	[d] 111

[a] Measurement made in morning, at a rough section below the gage.
[b] Measurement made on Tensleep Creek above mouth of Canyon Creek, and on Canyon Creek at mouth, and discharges added.
[c] Discharge of Canyon Creek, 24 second-feet; Tensleep Creek above Canyon Creek, 63 second-feet.
[d] Discharge of Canyon Creek, 29 second-feet; Tensleep Creek above Canyon Creek, 82 second-feet.

NOTE.—All measurements made by wading.

Daily gage height, in feet, and discharge, in second-feet, of Tensleep Creek near Tensleep, Wyo., for 1910.

[Miss Bessie Burke, observer.]

Day.	Sept.		Oct.		Nov.		Dec.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			0.32	78	0.22	70	0.10	61
2			.34	80	.21	69	.10	61
3			.35	81	.20	68	.09	60
4			.38	84	.19	67	.09	60
5			.37	83	.11	62	.08	60
6			.35	81	.17	66	.10	61
7			.34	80	.20	68	.09	60
8			.33	79	.19	67	.07	59
9			.32	78	.17	66	.09	60
10			.30	76	.15	64	.10	61
11			.28	74	.17	66	.11	62
12			.27	74	.16	65	.10	61
13			.26	73	.15	64	.11	62
14			.25	72	.13	63	.10	61
15			.25	72	.11	62	.09	60
16			.26	73	.10	61	.07	59
17			.25	72	.09	60	.08	60
18			.28	74	.07	59	.06	59
19			.29	75	.12	62	.07	59
20			.20	68	.11	62	.06	59
21	0.33	79	.22	70	.10	61	.06	59
22	.42	88	.24	71	.08	60	.05	58
23	.62	115	.25	72	.06	59	.06	59
24	.60	112	.23	70	.11	62	.04	57
25	.53	102	.22	70	.12	62	.05	58
26	.46	93	.23	70	.11	62	.04	57
27	.44	91	.16	65	.10	61	.03	57
28	.38	84	.18	67	.11	62	.02	56
29	.38	84	.21	69	.10	61	.01	56
30	.33	79	.20	68	.09	60	.02	56
31			.21	69			.01	56

NOTE.—These discharges are based on a fairly well defined rating curve.

Monthly discharge of Tensleep Creek near Tensleep, Wyo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
Sept. 21–30	115	79	93	1,840	B.
October	84	65	74	4,550	B.
November	70	59	63	3,750	B.
December	62	56	59	3,630	B.

PAINT ROCK CREEK NEAR BONANZA, WYO.

Paint Rock Creek rises in the Bighorn Mountains, flows southwestward, and joins No Wood River at Bonanza post office, Wyo. Its tributaries all enter above the station and all are small mountain streams.

The gaging station, which was established July 28, 1910, is located about 1½ miles from Bonanza post office and 12 miles from Manderson, Wyo., near the farmhouse of William Paumer.

The chain gage is located on the right bank of the stream, directly in front of the house of the observer. Discharge measurements are made by wading at the gage at low and ordinary stages, and from the highway bridge, one-fourth mile below, at flood stages.

The bed of the stream is rocky and clean, and probably nonshifting. The winter discharge is affected by ice.

Some water is diverted above the station for irrigation.

Discharge measurements of Paint Rock Creek near Bonanza, Wyo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 28	Raymond Richards	38	36	2.61	40
Aug. 26	J. C. Beebe	38	29	2.42	19
Sept. 18	....do	38	35	2.69	40
Sept. 23	....do	40	44	2.87	62

NOTE.—All measurements made by wading at same section, which is practically the same as the one of the chain gage.

Daily gage height, in feet, and discharge, in second-feet, of Paint Rock Creek near Bonanza, Wyo., for 1910.

[W. Paumer, observer.]

Day.	July.		Aug.		Sept.		Oct.		Nov.		Dec.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			2.50	25	2.40	18	2.91	66	2.92	67	2.83	57
2			2.50	25	2.40	18	2.91	66	2.92	67	2.83	57
3			2.50	25	2.45	22	3.00	77	2.92	67	2.83	57
4			2.50	25	2.40	18	3.04	82	2.92	67	2.82	56
5			2.50	25	2.35	16	3.10	89	2.93	69	2.82	56
6			2.40	18	2.40	18	3.10	89	2.94	70	2.82	56
7			2.40	18	2.35	16	3.10	89	2.92	67	2.81	55
8			2.40	18	2.40	18	3.03	80	2.92	67	(a)	
9			2.40	18	2.35	16	3.03	80	3.00	77		
10			2.40	18	2.40	18	3.03	80	3.00	77		
11			2.40	18	2.50	25	3.01	78	2.92	67		
12			2.40	18	2.45	22	3.01	78	2.91	66		
13			2.40	18	2.50	25	3.01	78	2.91	66		
14			2.40	18	2.55	28	3.00	77	2.91	66		
15			2.45	22	2.55	28	3.00	77	2.90	65		
16			2.40	18	2.65	39	3.00	77	2.90	65		
17			2.40	18	2.65	39	3.00	77	2.80	54		
18			2.40	18	2.70	44	3.00	77	2.80	54		
19			2.40	18	2.65	39	2.94	70	2.92	67		
20			2.45	22	2.70	44	2.94	70	2.92	67		

a Ice from about Dec. 8 to 31.

Daily gage height, in feet, and discharge, in second-feet, of Paint Rock Creek near Bonanza, Wyo., for 1910—Continued.

Day.	July.		Aug.		Sept.		Oct.		Nov.		Dec.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
21			2.35	16	2.70	44	3.02	79	2.92	67		
22			2.40	18	2.70	44	3.02	79	2.92	67		
23			2.35	16	2.86	61	2.94	70	2.92	67		
24			2.35	16	2.85	60	2.94	70	2.92	67		
25			2.45	22	2.93	69	2.94	70	2.92	67		
26			2.40	18	3.01	78	3.00	77	2.92	67		
27			2.45	22	3.02	79	3.00	77	2.92	67		
28	2.60	34	2.40	18	3.02	79	3.00	77	2.92	67		
29		[a] 30	2.40	18	3.02	79	3.00	77	2.92	67		
30	2.50	25	2.45	22	2.92	67	2.92	67	2.84	58		
31	2.50	25	2.40	18			2.92	67				

[a] Interpolated.

NOTE.—These discharges are based on a curve that is fairly well defined.

Monthly discharge of Paint Rock Creek near Bonanza, Wyo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
August	25	16	19.6	1,210	B.
September	79	16	39.0	2,320	B.
October	89	66	76.4	4,700	B.
November	77	54	66.4	3,950	B.
Dec. 1–7	57	55	56.3	808	B.

GREYBULL RIVER BASIN.

DESCRIPTION.

Greybull River rises in the Shoshone Range of the Rockies and flows northeastward to its junction with Bighorn River just below Basin, Wyo.

Greybull River has numerous tributaries, many of them small intermittent streams. Wood River, the largest tributary, rises in the mountains to the south of the Greybull and joins the main stream about 9 miles above Meeteetse, Wyo.

Irrigation is carried on quite extensively on the Greybull and its branches. A project to divert water from Wood River and discharge it into a reservoir on Grass Creek is now under way.

GREYBULL RIVER NEAR MEETEETSE, WYO.

This station, which is about 5 miles from Meeteetse, Wyo., on the road to Sunshine and Wilson's mine, 300 feet from Wilson's house, was established September 14, 1910. The principal tributary above the station is Wood River.

A staff gage is fastened to south span of the middle pier on the upstream side of the bridge. Gage datum has remained constant. At flood stages discharge measurements are made from the upstream side of the bridge. Low-water measurements are made by wading either above or below the bridge.

The bed of the stream is rocky.

The following discharge measurement was made by J. C. Beebe:

September 15, 1910: Width, 56 feet; area, 70 square feet; gage height, 0.68 feet; discharge, 127 second-feet. Made by wading about 100 feet above the gage.

Daily gage height, in feet, of Greybull River near Meeteetse, Wyo., for 1910.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		0.98	0.98	0.85	16	0.81	0.96	0.70	0.96
2		1.01	.96	.85	17	1.30	1.01	.78	1.04
3		1.02	.94	.83	18	.86	.99	.85	1.65
4		.98	.86	.82	19	.98	.97	.88	1.78
5		.97	.78	.79	20	.85	.78	.69	.98
6		1.06	.96	.75	21	.88	.89	.75	.98
7		1.03	.91	.76	22	2.34	.86	.70	3.00
8		.99	.86	.82	23	1.27	.90	.88	3.00
9		.97	.79	.85	24	1.06	.88	.85	2.68
10		.97	.89	.88	25	.98	.89	.80	3.00
11		.97	.87	.85	26	1.07	.99	.85	
12		.97	.84	.86	27	1.07	.92	.65	
13		.96	.82	.88	28	1.04	.98	.68	
14	0.68	.97	.74	.90	29	.98	1.02	.85	
15	.68	.97	.72	.94	30	.98	1.00	.88	
					31		.96		

NOTE.—Ice from about Dec. 17 to 31.

WOOD RIVER NEAR MEETEETSE, WYO.

This station, which is on the highway bridge 800 feet above the junction of Wood and Meeteetse rivers, 9 miles from Meeteetse post office, on the road running west to the Pitchfork ranch, was maintained from September 15 to December 10, 1910.

Cascade and Indian creeks, the principal tributaries of Wood River, enter the stream above the station. Some water is diverted above the station for irrigation.

A staff gage is fastened to the wind brace on the north side of the bridge. Discharge measurements are made from the downstream side of bridge and, at low water, by wading.

The bed of the stream is of gravel. The winter discharge is affected by ice.

The following discharge measurement was made by J. C. Beebe:

September 15, 1910: Width, 29 feet, area, 30 square feet; gage height, 0.77 feet; discharge, 62 second-feet.

Daily gage height, in feet, of Wood River near Meeteetse, Wyo., for 1910.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	.....	0.80	0.75	0.72	16	0.82	0.72	0.71	.....
2	.....	.85	.75	.70	17	.85	.71	.71	.....
3	.....	.82	.75	.70	18	.84	.73	.71	.....
4	.....	.81	.74	.70	19	.84	.72	.72	.....
5	.....	.80	.74	.70	20	.85	.70	.73	.....
6	.....	.81	.73	.70	21	.84	.70	.71	.....
7	.....	.81	.73	.70	22	.95	.70	.72	.....
8	.....	.78	.73	.70	23	.90	.68	.72	.....
9	.....	.75	.72	.70	24	.85	.67	.70	.....
10	.....	.75	.72	.70	25	.85	.69	.70	.....
11	.....	.75	.73	.....	26	.84	.72	.71	.....
12	.....	.74	.72	.....	27	.80	.77	.71	.....
13	.....	.74	.72	.....	28	.78	.80	.75	.....
14	.....	.73	.71	.....	29	.80	.77	.75	.....
15	0.78	.73	.71	.....	30	.78	.75	.75	.....
					31	.....	.77	.....	.....

NOTE.—Gage heights probably affected by ice Dec. 11 to 31.

SHOSHONE RIVER BASIN.

SHOSHONE RIVER AT CODY, WYO.

This station, which is located at the highway bridge 1 mile northeast of Cody, Wyo., was established April 26, 1902, to obtain data to be used in connection with the Shoshone reclamation project.

The principal tributaries are the North and South forks, which unite 8 miles above Cody to form the Shoshone. The drainage area above the gaging station is 1,400 square miles, but the entire run-off from this area does not pass the section, as a number of private irrigation canals, serving about 35,000 acres of land, divert water above the station. Below Cody irrigation has been carried on extensively by means of private canal systems that serve about 45,000 acres.

A staff gage, the datum of which has not changed, is spiked to a crib pier of the bridge. Measurements are made from the bridge.

The conditions for obtaining accurate discharge data are good. Ice does not affect the flow at this station as the river is kept open by springs which enter the river a short distance above the gage.

No gage heights were obtained in 1910.

The following discharge measurement was made by Raymond Richards:

March 16, 1910: Width, 128 feet; area, 352 square feet; gage height, 3.48 feet; discharge, 672 second-feet.

SHOSHONE RIVER AT CORBETT DAM, WYO.

This station, which is located 8 miles below Cody, Wyo., at the Corbett diversion dam built by the United States Reclamation Service, was established April 20, 1908.

The dam is a reenforced concrete structure of the buttressed type, having on the upstream side a deck 2½ feet thick, sloping 1 to 1, and supported by buttresses 2 feet thick, spaced 14 feet on centers. It raises the low-water elevation of the river 10.2 feet. The length between abutments is 400 feet. The estimates of discharge are com-

puted by considering the dam as a weir and the sluice and tunnel gates as submerged orifices.

Sage Creek, the only important tributary that enters between this station and that at Cody, drains only about 25 square miles.

The gage is situated 40 feet above the crest of the dam, and reads the height of the water above the crest.

Daily gage height, in feet, of Shoshone River at Corbett dam, Wyo., for 1910.

[J. A. Fleming, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		0.52	1.35	1.20	1.60	1.44	0.81	0.30	0.46	0.46
2		.54	1.17	1.30	1.60	1.44	.83	.32	.50	.45
3		.54	1.07	1.33	1.61	1.42	.80	.31	.48	.47
4		.54	1.04	1.34	1.61	1.40	.80	.31	.48	.46
5		.56	1.65	1.38	1.61	1.40	.79	.35	44	.47
6		.63	1.35	1.43	1.61	1.40	.77	.36	.45	.45
7		.65	1.35	1.43	1.61	1.39	.75	.38	.45	.43
8		.58	1.40	1.44	1.60	1.35	.70	.00	.45	.44
9		.72	1.53	1.44	1.62	1.32	.60	.40	56	.45
10		.80	1.68	1.42	1.60	1.30	.31	.40	.49	.46
11		.88	1.70	1.44	1.60	1.28	.30	.31	.50	.45
12		.96	1.90	1.50	1.58	1.25	.33	.30	.50	.45
13	0.54	1.05	1.92	1.48	1.58	1.23	.35	.30	.51	.43
14	.54	1.06	1.92	1.50	1.58	1.23	.34	.31	.51	.43
15	.58	.98	1.88	1.51	1.57	1.23	.33	.30	.46	.45
16	.60	.80	1.84	1.51	1.57	1.18	.32	.27	.44	.40
17	.65	.70	1.70	1.51	1.55	1.14	.31	.27	.42	.42
18	.74	.82	1.46	1.51	1.55	1.11	.38	.27	.37	.41
19	.90	1.14	1.22	1.52	1.57	1.07	.46	.33	.47	.43
20	.93	1.32	1.27	1.54	1.56	1.01	.34	.31	.45	.42
21	.95	1.38	1.30	1.55	1.55	.96	.32	23	.48	.42
22	.95	1.14	1.25	1.55	1.54	.92	.46	.33	.47	.43
23	.90	1.21	1.30	1.56	1.54	.92	.46	.40	.45	.38
24	.72	1.28	1.32	1.56	1.54	.91	.39	.40	.48	.43
25	.67	1.44	1.33	1.56	1.52	.89	.37	.39	.48	.42
26	.64	1.44	1.37	1.56	1.51	.86	.34	.42	.48	.40
27	.60	1.54	1.37	1.56	1.51	.85	.33	.46	.46	.40
28	.58	1.64	1.38	1.58	1.52	.84	.31	.43	.36	.40
29	.57	1.71	.90	1.59	1.50	.84	.31	.44	.46	.39
30	.49	1.52	.91	1.59	1.49	.83	.29	.43	.46	.39
31	.50		1.10		1.45	.81		.43		.40

NOTE.—The zero of the gage is the crest of the dam.

Daily discharge, in second-feet, of Shoshone River at Corbett dam, Wyo., for 1910.

[Shoshone River and sluices.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		502	2,420	2,040	3,110	2,660	1,160	368	414	414
2		534	1,970	2,290	3,110	2,660	1,200	392	470	400
3		534	1,730	2,370	3,140	2,600	1,140	380	442	428
4		534	1,660	2,390	3,140	2,560	1,140	380	442	414
5		566	3,250	2,500	3,140	2,560	1,120	428	386	428
6		681	2,420	2,640	3,140	2,560	1,090	440	400	400
7		715	2,420	2,640	3,140	2,520	1,050	962	400	372
8		598	2,560	2,660	3,110	2,420	960	894	400	386
9		836	2,910	2,660	3,170	2,340	790	528	566	400
10		980	3,340	2,600	3,110	2,290	380	330	456	414
11		1,140	3,400	2,660	3,110	2,240	368	222	470	400
12		1,310	4,020	2,820	2,950	2,160	404	210	470	400
13	534	1,520	4,090	2,780	2,950	2,120	428	210	486	372
14	534	1,540	4,090	2,820	2,950	2,120	416	222	486	372
15	598	1,360	3,960	2,860	3,030	2,120	404	210	414	400
16	630	980	3,830	2,860	3,030	1,990	392	182	386	330
17	715	800	3,400	2,860	2,970	1,900	380	182	358	358
18	872	1,020	2,720	2,860	2,970	1,820	464	182	294	344
19	1,180	1,740	2,090	2,880	3,030	1,730	573	246	428	372
20	1,250	2,180	2,220	2,940	3,000	1,580	416	222	400	358

Daily discharge, in second-feet, of Shoshone River at Corbett dam, Wyo., for 1910—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	1,290	2,500	2,290	2,970	2,970	1,470	392	144	442	358
22	1,290	1,900	2,160	2,970	2,940	1,380	573	894	428	372
23	1,180	2,060	2,290	3,000	2,940	1,380	573	1,020	400	306
24	836	2,240	2,340	3,000	2,940	1,360	476	330	442	372
25	749	2,660	2,370	3,000	2,880	1,320	452	318	442	358
26	698	2,660	2,480	3,000	2,860	1,260	416	358	442	330
27	630	2,940	2,480	3,000	2,860	1,240	404	414	414	330
28	598	3,230	2,500	3,050	2,880	1,220	380	372	282	330
29	582	3,430	1,340	3,080	2,820	1,220	380	386	414	318
30	456	2,880	1,360	3,080	2,800	1,200	358	372	414	318
31	470	.....	1,800	.....	2,680	1,160	.....	372	.....	330

Monthly discharge of Shoshone River and sluices at Corbett dam, Wyo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
March 13-31	1,290	456	794	29,900
April	3,430	502	1,550	92,200
May	4,090	1,340	2,640	162,000
June	3,080	2,040	2,780	165,000
July	3,170	2,680	3,000	184,000
August	2,660	1,160	1,910	117,000
September	1,200	358	623	37,100
October	1,020	144	393	24,200
November	566	282	423	25,200
December	428	306	370	22,800
The period	.....	.....	.....	859,000

Daily discharge, in second-feet, of Corbett tunnel at Corbett dam, Wyo., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	73	258	188	262	276	172	127	34
2	.....	74	258	221	215	276	172	127	39
3	.....	74	257	249	187	276	164	127	39
4	.....	74	257	260	200	276	155	127	39
5	.....	74	184	261	231	276	155	127	39
6	.....	74	42	262	231	248	155	127	10
7	.....	74	68	275	231	230	155	127	.....
8	.....	74	101	282	250	230	154	126	.....
9	.....	74	122	282	262	230	153	147	.....
10	.....	74	122	282	262	230	142	219	.....
11	.....	75	122	282	262	230	135	274	.....
12	.....	75	124	282	272	230	135	274	.....
13	46	56	124	282	277	230	135	274	.....
14	74	44	124	282	277	230	135	279	.....
15	74	44	124	282	277	206	135	284	.....
16	74	44	79	282	277	191	135	284	.....
17	74	43	52	282	277	170	135	284	.....
18	74	111	52	289	277	159	135	284	.....
19	75	154	52	293	277	142	144	284	.....
20	75	180	52	293	277	132	149	284	.....
21	75	196	68	293	277	145	149	284	.....
22	75	194	78	293	277	177	149	191	.....
23	75	195	78	293	277	188	149	184	.....
24	74	195	78	293	277	199	149	128	.....
25	74	196	114	293	277	199	149	101	.....
26	74	245	138	293	276	198	149	54	.....
27	74	276	147	283	276	198	149	26	.....
28	74	267	156	262	276	198	137	26	.....
29	74	262	156	262	276	198	127	26	.....
30	73	261	156	262	276	198	127	26	.....
31	73	.....	156	.....	276	190	.....	26	.....

NOTE.—These discharges were computed considering the gate openings as submerged orifices.

Monthly discharge of Corbett tunnel at Corbett dam, Wyo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
March 13–31	75	46	72.7	2,740
April	276	43	128	7,620
May	258	42	126	7,750
June	293	188	275	16,400
July	277	187	262	16,100
August	276	132	211	13,000
September	172	127	146	8,690
October	284	26	170	10,500
November 1–6	39	10	33.3	396
The period				83,200

NOTE.—Considering the uncertainties involved in the method of computation, the accuracy of the above monthly mean is not better than "C."

KNIFE RIVER BASIN.

DESCRIPTION.

Knife River rises in the northeast portion of Billings County, N. Dak., and flows eastward to Missouri River at Stanton, N. Dak., 90 miles in a direct line. It drains a basin whose greatest width is 40 miles and whose area comprises about 2,500 square miles. One-fifth of this basin is drained by the chief tributary, Spring Creek, which enters the Knife about 20 miles above its mouth.

Altitudes range from 1,700 to 2,500 feet above sea level. The mean annual rainfall ranges from 15 to 17 inches. There are no forests and only a few scattered trees along the streams.

Through most of the year the flow is small, but owing to the steep slopes of the sides of the valley there are occasional sudden floods after heavy rains.

The land in the lower portion of the valley is very favorably located for irrigation if the flood waters can be stored, but no really economical localities for storage have yet been found.

KNIFE RIVER NEAR BRONCHO, N. DAK.

This station, which is located at C. D. Smith's ranch, in the SE. ¼ sec. 4, T. 142 N., R. 90 W., the former site of the post office of Broncho, N. Dak., was established on May 29, 1903, to determine the amount of water available for irrigation. The present post office is some 6 miles away from the old site.

Spring Creek enters about 15 miles below the station and Elm Creek one-half mile above. The drainage area is 1,260 square miles.

The station was originally 2 miles farther down the river, but it was moved to its present location March 23, 1905, and since that time the gage datum has been unchanged. The drainage areas at the two locations are practically identical, the area at the lowest point being perhaps about 5 square miles greater.

No discharge measurements were made in 1910.

The channel at this point does not change perceptibly. Sufficient discharge measurements at high stages have not yet been made to check the rating curve satisfactorily, but it is approximately defined.

The chain gage is located on the left bank of the stream just below the observer's house. Measurements are made from a car and cable in flood just below the gage. Low-water measurements are made by wading.

Daily gage height, in feet, of Knife River near Broncho, N. Dak., for 1910.

[C. D. Smith, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	4.3	3.7	3.7	3.6	3.5	3.6	3.6	3.6
2	.....	4.4	3.7	3.7	3.6	3.5	3.6	3.6	3.6
3	.....	4.4	3.7	3.7	3.6	3.4	3.6	3.6	3.6
4	.....	4.3	3.7	3.7	3.55	3.4	3.6	3.6	3.6
5	8.15	4.3	3.7	3.6	3.55	3.4	3.6	3.6	3.6
6	15.65	4.2	3.7	3.6	3.5	3.4	3.6	3.6	3.6
7	16 0	4.2	3.7	3.6	3.5	3.4	3.6	3.6	3.6
8	14.25	4.1	3.7	3.6	3.5	3.5	3.6	3.6	3.6
9	12.2	4.0	3.7	3.7	3.5	3.5	3.6	3.6	3.6
10	10.6	4.0	3.7	6.0	3.5	3.5	3.6	3.6	3.6
11	13.4	4.0	3.7	6.8	3.5	3.6	3.6	3.6	3.6
12	17.6	3.8	3.7	5.2	3.5	3.6	3.6	3.6	3.6
13	16.4	3.8	3.7	5.0	3.5	3.6	3.7	3.6	3.7
14	13.0	3.8	3.7	4.6	3.5	3.6	3.7	3.6	3.7
15	10.2	3.8	3.7	4.2	3.5	3.6	3.7	3.6	3.7
16	8.2	3.9	3.7	4.0	3.5	3.6	3.7	3.6	3.7
17	6.7	3.9	3.8	3.9	3.4	3.6	3.7	3.6	3.7
18	6.2	3.9	3.8	3.9	3.4	3.6	3.7	3.6	3.7
19	5.85	3.9	3.8	3.8	3.4	3.6	3.7	3.6	3.7
20	5.45	3.9	3.8	3.7	3.4	3.6	3.7	3.6	3.7
21	5.15	3.9	3.8	3.7	3.4	3.6	3.7	3.6	3.7
22	4.95	3.9	3.8	3.7	3.4	3.6	3.7	3.6	3.7
23	4.85	3.9	3.7	3.7	3.4	3.6	3.7	3.6	3.7
24	4.55	3.9	3.7	3.7	3.5	3.6	3.7	3.6	3.7
25	4.4	3.9	3.7	3.7	3.6	3.6	3.6	3.6	3.7
26	4.3	3.8	3.7	3.7	3.8	3.6	3.6	3.6	3.7
27	4.4	3.8	3.7	3.7	3.8	3.6	3.6	3.6	.....
28	4.4	3.8	3.7	3.7	3.8	3.6	3.6	3.6	.....
29	4.4	3.8	3.7	3.7	3.7	3.6	3.6	3.6	.....
30	4.3	3.8	3.7	3.7	3.7	3.6	3.6	3.6	.....
31	4.3	.....	3.7	.....	3.6	3.6	.....	3.6	.....

NOTE.—Ice probably existed during January, February, and Mar. 1 to 4, and after Nov. 27.

Daily discharge, in second-feet, of Knife River near Broncho, N. Dak., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	59	14	14	10	7	10	10	10
2	.....	70	14	14	10	7	10	10	10
3	.....	70	14	14	10	4	10	10	10
4	.....	59	14	14	8	4	10	10	10
5	764	59	14	10	8	4	10	10	10
6	2,730	49	14	10	7	4	10	10	10
7	2,810	49	14	10	7	4	10	10	10
8	2,410	40	14	10	7	7	10	10	10
9	1,760	32	14	14	7	7	10	10	10
10	1,360	32	14	318	7	7	10	10	10
11	2,160	32	14	471	7	10	10	10	10
12	3,210	19	14	181	7	10	10	10	10
13	2,910	19	14	151	7	10	14	10	14
14	2,060	19	14	95	7	10	14	10	14
15	1,260	19	14	49	7	10	14	10	14

Daily discharge, in second-feet, of Knife River near Broncho, N. Dak., for 1910—Contd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	775	25	14	32	7	10	14	10	14
17	451	25	19	25	4	10	14	10	14
18	354	25	19	25	4	10	14	10	14
19	292	25	19	19	4	10	14	10	14
20	224	25	19	14	4	10	14	10	14
21	174	25	19	14	4	10	14	10	14
22	144	25	19	14	4	10	14	10	14
23	129	25	14	14	4	10	14	10	14
24	88	25	14	14	7	10	14	10	14
25	70	25	14	14	10	10	10	10	14
26	59	19	14	14	19	10	10	10	14
27	70	19	14	14	19	10	10	10	.....
28	70	19	14	14	19	10	10	10	.....
29	70	19	14	14	14	10	10	10	.....
30	59	19	14	14	14	10	10	10	.....
31	59	.....	14	.....	10	10	.....	10	.....

NOTE.—These discharges are based on a rating curve well defined below 82 second-feet.

Monthly discharge of Knife River near Broncho, N. Dak., for 1910.

[Drainage area, 1,260 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	[a] 5	.....	.....	307	
February	.....	.....	[a] 6	.....	.....	333	
March	3,210	.....	[a] 859	0.682	0.79	52,800	D.
April	70	19	32.4	.026	.03	1,930	C.
May	19	14	15.0	.012	.01	922	C.
June	471	10	54.3	.043	.05	3,230	B.
July	19	4	8.5	.0067	.01	521	C.
August	10	4	8.5	.0067	.01	526	C.
September	14	10	11.6	.0092	.01	690	C.
October	10	10	10.0	.0079	.01	615	C.
November	14	10	12.4	.0098	.01	738	C.
December	.....	.....	[1] 6	.....	.....	369	
The year	.....	.....	85.7	.....	.....	63,000	

[a] Discharge estimated Jan. 1 to Mar. 4 and Nov. 27 to Dec. 31 because of probable effect of ice.

NOTE.—The means for January, February, and December are only approximate.

PAINTED WOODS CREEK BASIN.

DESCRIPTION.

This drainage basin, comprising an area of about 900 square miles in McLean, Sheridan, and Burleigh counties, N. Dak., is drained by Painted Woods and Turtle creeks. Painted Woods Creek flows west and Turtle Creek south to their confluence in section 4, T. 143 N., R. 91 W., about 4 miles southeast of Washburn. Thence, by a 5-mile course, most of which is through a shallow lake known as Painted Woods Lake, the united stream flows to Missouri River.

Altitudes in this basin range from 1,700 to 2,400 feet above sea level. The region is a rolling prairie, treeless but covered by rank prairie grass or cultivated fields. The mean annual rainfall is about 16 inches.

PAINTED WOODS CREEK NEAR WASHBURN, N. DAK.

This station, which is located at the north side of sec. 34, T. 144 N., R. 81 W., about 6 miles southeast of Washburn, N. Dak., was maintained from March 10, 1909, to November 11, 1910, under the supervision of T. R. Atkinson, State engineer of North Dakota.

The drainage area above the station comprises about 390 square miles.

The equipment consists of a staff gage attached to a stake. Discharge measurements are made by wading or from a cable about 500 feet downstream, except at very high stages, when a highway bridge in section 33, 2 miles below the gage, can be used.

In 1910 the spring flood came unexpectedly early and was unusually small and brief.

Sufficient discharge measurements covering all stages have not been made at this station to properly define a rating curve.

Discharge measurements of Painted Woods Creek near Washburn, N. Dak., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 21[a]	J. W. Bliss	19	27	4.20	55
25[b]	do	37	75	4.00	180
June 16	T. Dickinson	6.6	8.9	1.10	5.4
July 9	do	5.3	2.9	.70	1.3
1910.					
Mar. 29	J. W. Bliss	4.5	5.7	1.10	2.0

[a] Ice.

[b] A little ice in the channel.

Daily gage height, in feet, of Painted Woods Creek near Washburn, N. Dak., for 1909–10.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.										
1		3.5	1.0	1.3	0.9	0.5	0.5	0.6	0.6	0.5
2		3.1	1.0	1.4	.9	.5	.7	.6	.6	.5
3		2.7	.9	1.3	.8	.5	.6	.6	.6	.5
4		2.5	.9	1.3	.8	.5	.5	.6	.6	.5
5		2.3	.9	1.3	.7	.9	.6	.6	.6	.5
6		2.2	.9	1.3	.7	1.1	.5	.6	.6	.6
7		2.1	.9	1.2	.7	.9	.5	.7	.6	.6
8		1.8	.8	1.2	.8	.7	.5	.6	.6	.7
9		1.7	.8	1.3	.7	.6	.5	.6	.6	.7
10	4.2	2.0	.8	1.2	.7	.7	.5	.6	.6	.7
11	4.2	1.5	.8	1.2	.7	.7	.4	.6	.6	.7
12	4.2	1.5	.8	1.2	.7	.6	.5	.6	.6	.7
13	4.2	2.4	.8	1.2	.7	.6	.6	.6	.6	1.5
14	4.2	1.5	.8	1.2	.7	.6	.5	.6	.6	.8
15	4.2	1.5	.7	1.2	.6	.6	.4	.6	.6	.8

Daily gage height, in feet, of Painted Woods Creek near Washburn, N. Dak., for 1909–10
Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.										
16	4.2	1.4	0.7	1.1	0.6	0.6	0.5	0.6	0.6	1.3
17	4.2	1.4	.7	1.1	.6	.6	.5	.6	.6	1.2
18	4.4	1.3	.7	1.0	.6	.6	.5	.6	.6	1.2
19	4.4	1.3	.8	1.0	.6	.6	.5	.6	.6	1.2
20	4.5	1.3	.8	1.0	.6	.5	.6	.6	.6	1.2
21	4.4	1.3	.7	1.0	.6	.5	.6	.6	.6	1.2
22	4.4	1.2	.8	1.0	.6	.5	.6	.6	.6	1.2
23	4.4	1.1	.8	.9	.6	.5	.5	.6	.6	1.2
24	4.3	1.1	.7	.9	.6	.6	.5	.6	.6	1.2
25	4.2	1.1	1.0	.9	.7	.6	.5	.6	.6	1.2
26	3.8	1.0	1.1	.9	.7	.5	.6	.6	.6	1.2
27	3.7	1.0	1.2	.9	.6	.5	.6	.6	.6	1.2
28	3.7	.9	1.2	.9	.6	.5	.6	.6	.6	1.2
29	3.5	.9	1.2	.9	.6	.4	.6	.6	.6	1.2
30	3.5	1.0	1.2	1.1	.6	.4	.6	.6	.5	1.2
31	3.5	.....	1.2	.....	.6	.4	.....	.6	.....	1.2
1910.										
1	.....	1.1	.8	.5	1.0	.6	.6	.6	.6	.....
2	.....	1.1	.8	.5	.9	.6	.6	.6	.6	.....
3	.....	1.0	.8	.5	.9	.6	.6	.6	.6	.....
4	.....	1.0	.8	.5	.8	.6	.6	.6	.6	.....
5	.....	1.0	.8	.5	.8	.6	.6	.6	.6	.....
6	.....	1.0	.8	.6	.8	.6	.6	.6	.6	.....
7	.....	1.0	.8	.6	.7	.6	.6	.6	.6	.....
8	.....	.9	.7	.7	.7	.6	.6	.6	.6	.....
9	.....	.9	.7	.7	.7	.6	.6	.6	.6	.....
10	.....	.9	.7	.8	.7	.6	.6	.6	.6	.....
11	.....	.9	.7	.8	.8	.6	.6	.6	.6	.....
12	.....	.9	.7	.8	.8	.6	.6	.6	.....	.....
13	2.6	.9	.7	.7	.8	.6	.6	.6	.....	.....
14	2.6	.9	.7	.7	.8	.6	.6	.6	.....	.....
15	2.4	.9	.7	.7	.7	.6	.6	.6	.....	.....
16	1.9	.9	.7	.6	.7	.6	.6	.6	.....	.....
17	2.1	1.0	.7	1.65	.7	.6	.6	.6	.....	.....
18	2.1	1.0	.7	1.0	.6	.6	.6	.6	.....	.....
19	1.9	1.0	.7	1.0	.6	.6	.6	.7	.....	.....
20	1.7	.9	.7	1.0	.6	.6	.6	.7	.....	.....
21	1.6	.9	.7	1.0	.5	.6	.6	.7	.....	.....
22	1.5	.8	.7	.9	.5	.6	.6	.7	.....	.....
23	1.4	.8	.7	.9	.9	.6	.6	.6	.....	.....
24	1.3	.8	.7	.8	.9	.6	.6	.6	.....	.....
25	1.2	.8	.6	.8	.8	.6	.6	.6	.....	.....
26	1.1	.8	.6	.8	.8	.6	.6	.6	.....	.....
27	1.1	.8	.6	.7	.7	.6	.6	.6	.....	.....
28	1.0	.8	.6	.7	.6	.6	.6	.6	.....	.....
29	1.0	.8	.6	.7	.6	.6	.6	.6	.....	.....
30	1.1	.8	.6	1.4	.6	.6	.6	.6	.....	.....
31	1.1	.....	.5	.....	.6	.6	.....	.6	.....	.....

NOTE.—Ice probably in January, February, greater part of March, December, 1909, January, February, and first part of March, 1910, and after Nov. 11, 1910.

TURTLE CREEK NEAR WASHBURN, N. DAK.

This station, which is located at the highway bridge near the northwest corner of sec. 15, T. 144 N., R. 81 W., about 4 miles northeast of Washburn, N. Dak., was maintained from March 10, 1909, to November 16, 1910, under the supervision of T. R. Atkinson, State engineer of North Dakota.

The drainage area above the station is about 440 square miles.

A staff gage is attached to bridge from which discharge measurements are made.

Sufficient discharge measurements covering all stages have not been made at this station to properly define a rating curve.

In 1910 the spring breakup was unexpectedly and unprecedentedly early and the spring flood unusually small and brief.

Discharge measurements of Turtle Creek near Washburn, N. Dak., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 26[a]	J. W. Bliss	28	42	5.50	94
June 16	T. Dickinson	8	12	2.20	18
1910					
Mar. 30	J. W. Bliss	3.5	5.1	2.50	2.4

[a] Water running over ice.

Daily gage height, in feet, of Turtle Creek near Washburn, N. Dak., for 1909–10.

[Erick Larson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.										
1	.....	3.8	2.3	2.7	2.1	1.7	1.4	1.7	1.9	1.8
2	.....	3.7	2.3	2.8	2.0	1.7	1.7	1.7	1.9	1.8
3	.....	3.8	2.3	3.1	2.0	1.7	1.7	1.7	1.9	1.8
4	.....	4.0	2.3	3.0	2.0	1.7	1.7	1.7	1.9	1.8
5	.....	3.7	2.3	2.8	2.0	1.7	1.7	1.7	1.9	1.8
6	.....	3.4	2.3	2.6	2.0	1.7	1.6	1.7	1.9	1.8
7	.....	3.2	2.2	2.5	2.0	1.7	1.6	1.7	1.9	1.8
8	.....	3.1	2.2	2.4	2.1	1.7	1.6	2.0	1.9	1.8
9	.....	2.8	2.2	2.5	2.0	1.7	1.6	2.0	1.9	1.8
10	4.1	2.4	2.1	2.5	2.0	1.8	1.5	1.9	1.9	1.8
11	4.1	2.9	2.1	2.4	2.0	1.8	1.5	1.9	1.9	1.8
12	4.0	2.6	2.1	2.4	1.9	1.8	1.4	1.9	1.9	1.8
13	4.0	2.4	2.1	2.7	1.9	1.8	1.9	1.8	1.8	1.8
14	4.0	2.5	2.1	2.6	1.9	1.8	1.8	1.8	1.8	1.8
15	4.0	2.5	2.1	2.5	1.9	1.8	1.7	1.8	1.8	1.8
16	4.0	2.5	2.1	2.2	1.9	1.7	1.6	1.8	1.8	1.8
17	4.0	2.5	2.1	2.2	1.9	1.7	1.5	1.9	1.8	1.8
18	4.0	2.5	2.1	2.1	1.9	1.6	1.4	1.9	1.8	1.8
19	4.0	2.4	2.1	2.1	1.8	1.6	1.7	1.9	1.8	1.8
20	4.2	2.4	2.1	2.1	1.8	1.6	1.7	1.9	1.8	1.8
21	4.2	2.3	2.1	2.1	1.8	1.6	1.7	1.9	1.8	1.8
22	4.8	2.3	2.1	2.1	1.8	1.5	1.7	1.9	1.8	1.8
23	5.0	2.2	2.1	2.0	1.8	1.5	1.7	1.9	1.8	1.8
24	4.7	2.2	2.1	2.0	1.8	1.5	1.7	1.9	1.8	1.8
25	5.3	2.2	2.5	2.0	2.0	1.5	1.7	1.9	1.8	1.7
26	5.6	2.3	2.4	2.1	1.9	1.5	1.7	1.9	1.8	1.7
27	5.3	2.2	2.5	2.0	1.8	1.5	1.7	1.9	1.8	1.7
28	4.4	2.2	2.5	2.0	1.8	1.5	1.7	1.9	1.8	1.7
29	4.2	2.2	2.5	2.0	1.8	1.5	1.7	1.9	1.8	1.7
30	4.0	2.2	2.7	2.3	1.7	1.4	1.7	1.9	1.8	1.7
31	4.0	.....	2.7	.....	1.7	1.4	.....	1.9	.....	1.7
1910.										
1	.....	2.3	2.2	1.9	2.0	2.1	1.7	1.7	1.8	.....
2	.....	2.3	2.2	1.9	2.0	2.1	1.7	1.7	1.8	.....
3	.....	2.3	2.2	1.9	1.8	2.0	1.7	1.7	1.8	.....
4	.....	2.3	2.2	1.9	1.8	2.0	1.7	1.7	1.8	.....
5	.....	2.3	2.2	1.9	1.7	1.9	1.7	1.7	1.8	.....
6	.....	2.3	2.1	1.9	1.7	1.9	1.7	1.7	1.8	.....
7	.....	2.3	2.1	1.9	1.6	1.9	1.7	1.7	1.8	.....
8	.....	2.3	2.1	1.9	1.6	1.9	1.7	1.7	1.8	.....
9	.....	2.3	2.1	2.5	1.6	1.8	1.7	1.7	1.8	.....
10	.....	2.3	2.1	2.5	1.6	1.8	1.7	1.7	1.8	.....

Daily gage height, in feet, of Turtle Creek near Washburn, N. Dak., for 1909–10—Contd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910.										
11	.....	2.3	2.1	2.0	1.7	1.8	1.7	1.7	1.8	.....
12	.....	2.3	2.1	2.0	1.7	1.7	1.7	1.7	1.8	.....
13	5.3	2.2	2.1	2.0	1.7	1.7	1.7	1.7	1.8	.....
14	4.8	2.2	2.1	2.0	1.7	1.7	1.7	1.7	1.8	.....
15	4.0	2.3	2.1	2.0	1.6	1.8	1.7	1.7	1.8	.....
16	3.8	2.3	2.2	2.0	1.6	1.8	1.7	1.7	1.8	.....
17	3.5	2.3	2.2	2.0	1.6	1.8	1.7	1.7	.....	.....
18	3.2	2.3	2.2	3.5	1.5	1.8	1.7	1.7	.....	.....
19	2.8	2.3	2.2	2.5	1.5	1.7	1.7	2.0	.....	.....
20	2.6	2.3	2.2	2.2	1.4	1.7	1.7	2.0	.....	.....
21	2.6	2.3	2.2	2.2	1.3	1.7	1.7	2.0	.....	.....
22	2.6	2.3	2.1	2.1	1.3	1.7	1.7	2.0	.....	.....
23	2.5	2.3	2.1	2.0	2.9	1.7	1.7	1.9	.....	.....
24	2.5	2.3	2.0	2.0	2.7	1.7	1.7	1.9	.....	.....
25	2.5	2.3	2.0	2.0	2.7	1.7	1.7	1.8	.....	.....
26	2.3	2.3	2.0	2.0	2.7	1.7	1.7	1.8	.....	.....
27	2.3	2.3	2.0	1.9	2.5	1.7	1.7	1.8	.....	.....
28	2.3	2.2	2.0	1.8	2.3	1.7	1.7	1.8	.....	.....
29	2.3	2.2	2.0	1.7	2.3	1.7	1.7	1.8	.....	.....
30	2.5	2.2	2.0	1.7	2.3	1.7	1.7	1.8	.....	.....
31	2.3	.....	2.0	.....	2.2	1.7	.....	1.8	.....	.....

NOTE.—Ice probably affected flow in January, February, and greater part of March, 1909, January, February, and first part of March, 1910, and after Nov. 16, 1910.

HEART RIVER BASIN.

DESCRIPTION.

Heart River rises in eastern Billings County, N. Dak., flows eastward and southeastward for about 100 miles by general course, then turns abruptly to the north and northeast for 30 miles, and enters Missouri River at Mandan, N. Dak. The entire drainage area is 3,350 square miles.

The largest tributaries are Big Muddy Creek, which enters from the north a few miles above the big bend and drains 480 square miles, and Green River, which is one of the headwaters and drains 340 square miles.

Altitudes range from 1,640 feet above sea level at Mandan to about 2,700 feet at the western boundary of the basin. The mean annual rainfall is from 13 to 17 inches, of which about half falls in the three months of May, June, and July. There is no forestation, merely scattering fringes and groves along the streams.

HEART RIVER NEAR RICHARDTON, N. DAK.

This station, which is located at the steel highway bridge 10 miles south of Richardton, N. Dak., in or near sec. 21, T. 138, R. 92, and half a mile below the mouth of Blacktail Creek, was established May 18, 1903, to determine the amount of water available for irrigation. The drainage area above this point is 1,250 square miles.

The datum of the gage has been unchanged, but the channel bottom is not permanent, and occasional small changes in the rating curve are required. No extreme high-stage measurements have yet been obtained, and not enough medium high-stage measurements to properly define the upper portion of the rating curve; hence the estimates of the extreme floods are only approximate. A standard chain gage is fastened securely to the downstream side of the highway bridge. Flood measurements are made from this bridge.

No discharge measurements were made in 1910.

Daily gage height, in feet, of Heart River near Richardton, N. Dak., for 1910.

[W. F. Church, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	5.4	4.4	4.1	4.3	4.0	3.9	3.9	4.0
2	.....	5.3	4.4	4.1	4.3	4.0	3.9	3.9	4.0
3	.....	5.2	4.4	4.1	4.3	4.0	3.9	3.9	4.0
4	.....	5.1	4.4	4.1	4.3	3.9	3.9	3.9	4.0
5	5.3	5.0	4.3	4.1	4.3	3.9	3.9	3.9	4.0
6	6.0	4.9	4.3	4.1	4.3	3.9	3.9	4.0	4.0
7	9.8	4.9	4.3	4.1	4.3	3.9	3.9	4.0	4.0
8	11.6	4.8	4.3	4.1	4.9	3.9	3.9	4.0	4.0
9	13.1	4.8	4.3	4.2	4.8	3.9	3.9	4.0	4.0
10	14.2	4.7	4.3	4.6	4.7	4.0	3.9	4.0	4.1
11	15.5	4.7	4.2	5.0	4.6	4.0	3.9	4.0	4.2
12	16.7	4.6	4.2	5.2	4.5	4.0	4.0	4.0	4.2
13	18.0	4.6	4.2	5.4	4.4	4.2	4.0	4.0	4.2
14	19.4	4.5	4.3	5.5	4.3	4.2	4.0	4.0	4.2
15	17.1	4.5	4.3	5.3	4.2	4.1	4.0	4.0	4.2
16	15.9	4.4	4.4	5.1	4.1	4.1	4.0	4.0	4.2
17	14.2	4.4	4.4	4.9	4.0	4.1	4.0	4.0	4.2
18	12.3	4.3	4.4	4.8	4.0	4.0	4.0	4.0	4.2
19	10.1	4.2	4.3	4.7	4.0	4.0	4.0	4.0	4.2
20	8.3	4.3	4.3	4.6	4.0	4.0	3.9	4.0	4.2
21	7.7	4.5	4.3	4.6	4.0	4.0	3.9	4.0	4.2
22	7.4	4.6	4.2	4.5	4.1	4.0	3.9	4.0	4.2
23	6.0	4.8	4.2	4.5	4.0	4.0	3.9	4.0	4.2
24	6.3	4.6	4.2	4.5	4.1	3.9	3.9	4.0	4.2
25	6.1	4.5	4.2	4.5	4.1	3.9	3.9	4.0	4.2
26	5.9	4.4	4.2	4.4	4.0	3.9	3.9	4.0	4.2
27	5.7	4.4	4.2	4.4	4.0	3.9	3.9	4.0	.....
28	5.6	4.4	4.2	4.4	4.0	3.9	3.9	4.0	.....
29	5.6	4.4	4.2	4.3	4.1	3.9	3.9	4.0	.....
30	5.5	4.4	4.2	4.3	4.1	3.9	3.9	4.0	.....
31	5.4	.....	4.2	.....	4.0	3.9	.....	4.0	.....

NOTE.—Ice probably prevailed Jan. 1 to Mar. 4 and after Nov. 26.

Daily discharge, in second-feet, of Heart River near Richardton, N. Dak., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	86	11	2	7	1	0.3	0.3	1
2	.....	75	11	2	7	1	.3	.3	1
3	.....	65	11	2	7	1	.3	.3	1
4	.....	56	11	2	7	.3	.3	.3	1
5	75	48	7	2	7	.3	.3	.3	1
6	167	40	7	2	7	.3	.3	1	1
7	935	40	7	2	7	.3	.3	1	1
8	1,450	33	7	2	40	.3	.3	1	1
9	1,960	33	7	4	33	.3	.3	1	1
10	2,350	27	7	21	27	1	.3	1	2
11	2,870	27	4	48	21	1	0.3	1	4
12	3,350	21	4	65	16	1	1	1	4
13	3,920	21	4	86	11	4	1	1	4
14	4,570	16	7	98	7	4	1	1	4
15	3,520	16	7	75	4	2	1	1	4

Daily discharge, in second-feet, of Heart River near Richardton, N. Dak., for 1910—Contd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	3,030	11	11	56	2	2	1	1	4
17	2,350	11	11	40	1	2	1	1	4
18	1,680	7	11	33	1	1	1	1	4
19	1,020	4	7	27	1	1	1	1	4
20	586	7	7	21	1	1	.3	1	4
21	462	16	7	21	1	1	.3	1	4
22	403	21	4	16	2	1	.3	1	4
23	167	33	4	16	1	1	.3	1	4
24	212	21	4	16	2	.3	.3	1	4
25	182	16	4	16	2	.3	.3	1	4
26	152	11	4	11	1	.3	.3	1	4
27	124	11	4	11	1	.3	.3	1	.....
28	111	11	4	11	1	.3	.3	1	.....
29	111	11	4	7	2	.3	.3	1	.....
30	98	11	4	7	2	.3	.3	1	.....
31	86	.....	4	.....	1	.3	.....	1	.....

NOTE.—These discharges are based on a rating curve that is fairly well defined below 520 second-feet.

Monthly discharge of Heart River near Richardton, N. Dak., for 1910.

[Drainage area, 1,250 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	*a* 3	.....	.....	184	
February	.....	.....	*a* 3	.....	.....	167	
March	4,570	.....	*a*1,160	0.928	1.07	71,300	D.
April	86	4	26.9	.022	.02	1,600	B.
May	11	4	6.6	.0053	.01	406	C.
June	98	2	24.1	.019	.02	1,430	B.
July	40	1	7.4	.0059	.01	455	C.
August	4	.3	.97	.00078	.001	60	D.
September	1	.3	.49	.00039	.0004	29	D.
October	1	.3	.89	.00071	.0008	55	D.
November	4	1	*a* 3.0	.0024	.003	179	D.
December	.....	.....	*a* 2	.....	.....	123	
The year	.....	.....	103	.....	.....	76,000	

a Discharge estimated Jan. 1 to Mar. 4 and Nov. 27 to Dec. 31.

NOTE.—The means for January, February, and December are only approximate.

GRAND RIVER BASIN.

NORTH FORK OF GRAND RIVER AT HALEY, N. DAK.

The North Fork of Grand River unites with the South Fork to form the Grand in the northeastern part of Butte County, S. Dak., the main stream flowing from this junction eastward across the Standing Rock Indian reservation to the Missouri.

This station, which is located about 20 rods south of the post office at Haley, N. Dak., near the northeast corner of sec. 36, T. 129, R. 100, was established May 17, 1908, to obtain data for the reclamation project under survey at that point. Two hundred feet below the staff gage is a standard car and cable outfit from which high-water

measurements may be made. Low-water measurements are made by wading.

The drainage area above the station includes only the North Fork of the Grand and comprises about 500 square miles.

The following discharge measurement was made by J. W. Bliss:

March 21, 1910: Width, 60 feet; area, 137 square feet; gage height, 2.60 feet; discharge, 90 second-feet.

Daily gage height, in feet, of North Fork of Grand River at Haley, N. Dak., for 1910.

[H. N. Lungwitz, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.6	1.2	1.1	1.0	0.9	0.9	0.9	0.9
2	.....	1.6	1.2	1.1	1.0	.9	.9	.9	.9
3	6.5	1.6	1.2	1.1	1.0	.9	.9	.9	.9
4	5.8	1.5	1.2	1.1	1.0	.9	.9	.9	.9
5	6.85	1.5	1.2	1.1	1.0	.9	.9	.9	.9
6	7.8	1.5	1.2	1.1	1.0	.9	.9	.9	.9
7	5.8	1.5	1.2	1.1	1.0	.9	.9	.9	.9
8	6.2	1.5	1.2	1.1	1.0	.9	.9	.9	.9
9	5.7	1.4	1.2	1.1	1.0	.9	.9	.9	.9
10	5.45	1.4	1.2	2.2	.9	.9	.9	.9	.9
11	6.4	1.4	1.2	2.05	.9	.9	.9	.9	.9
12	.....	1.4	1.2	1.85	.9	.9	.9	.9	.9
13	.....	1.4	1.2	1.35	.9	.9	.9	.9	.9
14	.....	1.4	1.2	1.3	.9	.9	.9	.9	.9
15	.....	1.4	1.2	1.3	.9	.9	.9	.9	.9
16	.....	3.0	1.2	1.3	.9	.9	.9	.9	.9
17	.....	3.5	1.2	1.3	.9	.9	.9	.9	.9
18	.....	1.95	1.2	1.2	.9	.9	.9	.9	.9
19	.....	1.8	1.2	1.2	.9	.9	.9	.9	.9
20	.....	1.7	1.2	1.2	.9	.9	.9	.9	.9
21	2.5	1.6	1.2	1.2	.9	.9	.9	.9	.9
22	2.35	1.5	1.2	1.2	.9	.9	.9	.9	.9
23	2.1	1.5	1.2	1.2	.9	.9	.9	.9	.9
24	2.0	1.4	1.1	1.7	.9	.9	.9	.9	.9
25	2.0	1.4	1.1	2.15	.9	.9	.9	.9	.9
26	1.9	1.4	1.1	1.55	.9	.9	.92	.9	.9
27	1.9	1.4	1.1	1.3	.9	.9	1.00	.9	.....
28	1.8	1.4	1.1	1.15	.9	.9	.95	.9	.....
29	1.8	1.35	1.1	1.1	.9	.9	.92	.9	.....
30	1.8	1.35	1.1	1.1	.9	.9	.90	.9	.....
31	1.7	.....	1.1	.....	.9	.9	.....	.9	.....

NOTE.—Gage heights probably affected by ice from Jan. 1 to Mar. 2 and after Nov. 27.

Daily discharge, in second-feet, of North Fork of Grand River at Haley, N. Dak., for 1908–1910.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.											
1	.....	.....	.....	.....	38	36	8	0.5	0.5	0.5	0.5
2	.....	.....	.....	.....	54	18	7	.5	.5	.5	.5
3	.....	.....	.....	.....	84	8	6	.5	.5	.5	.5
4	.....	.....	.....	.....	102	8	5	.5	.5	.5	.5
5	.....	.....	.....	.....	43	3.5	4	.5	.5	.5	.5
6	.....	.....	.....	.....	13	23	3	.5	.5	.5	.5
7	.....	.....	.....	.....	43	18	2	.5	.5	.5	.5
8	.....	.....	.....	.....	38	18	1	.5	.5	.5	.5
9	.....	.....	.....	.....	36	33	0	.5	.5	.5	.5
10	.....	.....	.....	.....	28	18	0	.5	.5	.5	.5
11	.....	.....	.....	2.0	23	3.5	0	5	.5	.5	.5
12	.....	.....	.....	2.5	26	.5	0	.5	.5	.5	.5
13	.....	.....	.....	2.5	18	.5	0	.5	.5	.5	.5
14	.....	.....	.....	2.5	102	.5	0	.5	.5	.5	.5
15	.....	.....	.....	3.0	227	.5	0	.5	.5	.5	.5

Daily discharge, in second-feet, of North Fork of Grand River at Haley, N. Dak., for 1908–1910—Continued.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.											
16				3.0	114	0.5	0.3	0.5	0.5	0.5	0.5
17				3.5	111	.2	.3	.5	.8	.5	.5
18				3.5	57	3	.3	1.1	.8	.5	.5
19				3.5	13	8	.3	1.1	4	.5	.5
20				164	48	8	.3	.5	4	.5	.5
21				234	23	8	.4	.5	2.6	.5	.5
22				288	43	8	.4	.5	.8	.5	.5
23				296	18	8	.4	.5	.8	.5	.5
24				164	8	8	.4	.5	.5	.5	.5
25				164	13	8	.4	.5	.5	.5	.5
26				126	23	8	.4	.5	.5	.5	.5
27				99	48	8	.4	.5	.5	.5	.5
28				54	23	8	.4	.5	.5	.5	.5
29				43	3.5	8	.5	.5	.5	.5	.5
30				43	38	8	.5	.5	.5	.5	.5
31				43		8	.5		.5		.5
1909.											
1		356	20	8	394	9	3.5	2	2	2	2
2		351	20	3.5	367	10	3.5	2	2	2	2
3		288	18	2.9	206	8	3.5	2	2	2	2
4		227	13	2.0	105	10	3.5	2	2	2	2
5		178	10	2.0	69	13	3.5	2	2	2	2
6		141	10	2.0	54	19	3.5	2	2	2	2
7	0.5	126	13	2.0	43	23	3.5	2	3.5	2	2
8	.5	123	10	3.5	44	23	3.5	2	3.5	2	2
9	.5	87	10	3.5	396	18	3.5	2	3.5	2	2
10	.5	102	5.8	3.5	199	18	3.5	2	2	2	2
11	.5	102	8	2.9	123	28	3.5	2	2	2	2
12	.5	102	8	.5	135	24	149	2	2	2	2
13	.5	102	8	.5	241	20	46	2	2	2	2
14	.5	102	7.1	.5	133	23	26	2	2	2	2
15	.5	72	5.8	.5	84	20	16	2	2	2	2
16	.5	43	5.8	.5	84	19	8	2	2	2	2
17	.5	33	3.5	3.5	46	13	8	2	2	2	2
18	.5	30	3.5	2.9	36	8	8	2	2	2	2
19	.5	40	3.5	2.9	27	5.8	7.1	2	2	2	2
20	.5	57	3.5	.5	26	5.8	5.8	2	2	2	2
21	20	57	3.5	.5	20	8	5.8	2	2	2	2
22	40	87	.5	.5	18	5.8	3.5	2	2	2	2
23	50	78	.5	3.5	18	5.8	3.5	2	2	2	2
24	60	60	.5	3.5	18	5.8	3.5	2	2	2	2
25	150	46	2.0	3.5	13	5.8	3.5	2	2	2	2
26	188	38	2.0	3.5	13	3.5	3.5	2	2	2	2
27	252	38	2.0	3.5	13	3.5	3.5	2	2	2	2
28	324	38	2.0	3.5	13	3.5	2	2	2	2	2
29		26	3.5	26	13	3.5	2	2	2	2	2
30		23	8	33	10	3.5	2	2	2	2	2
31		20		500		3.5	2		2		2
1910.											
1			33	13	8	3.5	.5	.5	.5	.5	
2			33	13	8	3.5	.5	.5	.5	.5	
3		374	33	13	8	3.5	.5	.5	.5	.5	
4		312	28	13	8	3.5	.5	.5	.5	.5	
5		405	28	13	8	3.5	.5	.5	.5	.5	
6		500	28	13	8	3.5	.5	.5	.5	.5	
7		312	28	13	8	3.5	.5	.5	.5	.5	
8		247	28	13	8	3.5	.5	.5	.5	.5	
9		304	23	13	8	3.5	.5	.5	.5	.5	
10		284	23	13	66	.5	.5	.5	.5	.5	
11		365	23	13	57	.5	.5	.5	.5	.5	
12		350	23	13	46	.5	.5	.5	.5	.5	
13		300	23	13	20	.5	.5	.5	.5	.5	
14		250	23	13	18	.5	.5	.5	.5	.5	
15		200	23	13	18	.5	.5	.5	.5	.5	
16		175	114	13	18	.5	.5	.5	.5	.5	
17		150	144	13	18	.5	.5	.5	.5	.5	
18		125	50	13	13	.5	.5	.5	.5	.5	
19		100	43	13	13	.5	.5	.5	.5	.5	
20		92	38	13	13	.5	.5	.5	.5	.5	

Daily discharge, in second-feet, of North Fork of Grand River at Haley, N. Dak., for 1908–1910—Continued.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910.											
21	.....	84	33	13	13	0.5	0.5	0.5	0.5	0.5	.....
22	.....	75	28	13	13	.5	.5	.5	.5	.5	.....
23	.....	60	28	13	13	.5	.5	.5	.5	.5	.....
24	.....	54	23	8	38	.5	.5	.5	.5	.5	.....
25	.....	54	23	8	63	.5	.5	.5	.5	.5	.....
26	.....	48	23	8	30	.5	.5	1.1	.5	.5	.....
27	.....	48	23	8	18	.5	.5	3.5	.5	.....	.....
28	.....	43	23	8	20	.5	.5	2.0	.5	.....	.....
29	.....	43	20	8	8	.5	.5	1.1	.5	.....	.....
30	.....	43	20	8	8	.5	.5	.5	.5	.....	.....
31	.....	38	.....	8	.....	.5	.5	.....	.5	.....	.....

NOTE.—These daily discharges for 1908–1910 are based on a rating curve that is well defined below 90 second-feet. Above this the curve is an extension and is approximate. Discharge interpolated or estimated May 12 to 16, July 18, Aug. 2 to 8, 1908; Feb. 20 to 24, 1909; Mar. 12 to 19, 1910.

Monthly discharge of North Fork of Grand River at Haley, N. Dak., for 1908–1910.

[Drainage area, 420 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1908.							
May	296	1.0	[a] 56.7	0.135	0.16	3,490	C.
June	227	3.5	48.7	.116	.13	2,900	B.
July	36	.2	9.57	.023	.03	588	C.
August	8	.0	1.36	.0032	.004	84	C.
September	1.1	.5	.54	.0013	.001	32	C.
October	4	.5	.83	.0020	.002	51	C.
November	.5	.5	.50	.0012	.001	30	D.
December	.5	.5	.50	.0012	.001	31	D.
The period	.....	.....	14.8	.035	.329	7,210	
1909.							
January	.....	.....	[a] 0	.0	.00	0	
February	324	.5	[a] 39	.093	.10	2,170	D.
March	356	20	103	.245	.28	6,330	C.
April	20	.5	7.03	.017	.02	418	B.
May	500	.5	20.3	.048	.06	1,250	C.
June	396	10	98.7	.235	.26	5,870	C.
July	28	3.5	11.9	.028	.03	732	C.
August	149	2	11.2	.027	.03	689	C.
September	2	2	2.0	.0048	.005	119	D.
October	3.5	2	2.15	.0051	.006	132	D.
November	2	2	2.0	.0048	.005	119	D.
December	2	2	2.0	.0048	.006	123	D.
The year	.....	.....	24.9	.059	.82	18,000	
1910.							
January	.....	.....	[a] 1.0	.0024	.003	61	
February	.....	.....	[a] 1.0	.0024	.002	56	
March	.....	.....	[a] 186	.443	.51	11,400	D.
April	144	20	34.4	.082	.09	2,050	B.
May	13	8	11.7	.028	.03	719	B.
June	66	8	19.9	.047	.05	1,180	B.
July	3.5	.5	1.37	.0033	.004	84	C.
August	.5	.5	.50	.0012	.001	31	D.
September	3.5	.5	.69	.0016	.002	41	D.
October	.5	.5	.50	.0012	.001	31	D.
November	.5	.5	[a] .50	.0012	.001	30	D.
December	.....	.....	[a] .5	.0012	.001	31	
The year	.....	.....	21.5	.051	.695	15,700	

[a] Discharge estimated May 1 to 10, 1908; Jan. 1 to Feb. 6, 1909; Jan. 1 to Mar. 2 and Nov. 27 to Dec. 31, 1910.

NOTE.—The means for January, 1909, January, February, and December, 1910, are only approximate.

NIOBRARA RIVER BASIN.[1]

DESCRIPTION.

Niobrara River rises in the mountains of eastern Wyoming, flows eastward through the northern portion of Nebraska, and empties into the Missouri in Knox County at the city of Niobrara. Its drainage basin is narrow in the upper portion but broadens considerably near the mouth; it comprises about 9,000 square miles.

Precipitation within the basin ranges from 15 to 18 inches in the upper portion, from 18 to 21 inches in the middle portion, and from 21 to 24 inches in the lower portion. Evaporation is 6, 5, and 4½ feet in the upper, middle, and lower portions, respectively. Sixty-nine per cent of the precipitation falls during April, May, June, July, and August, and about one-half of the remainder is snowfall.

The river is not subject to periodic rises of any importance, owing to the fact that the sand hills which form so large a portion of its drainage area act as storage reservoirs for the rain and snow, which are afterwards fed to the stream in the form of spring water, thus equalizing the flow and making the constancy of the discharge almost phenomenal.

The principal tributaries are Verdigris, Keyapaha, and Snake rivers and Minnechaduza Creek. The drainage area of the Snake is similar in nearly all respects to that of the western part of the Niobrara.

The water resources of the Niobrara are at present almost wholly undeveloped, irrigation being limited to the low, narrow flood plains in the bottoms of the canyons. On Minnechaduza Creek at Valentine an artificial lake has been formed by a dam, and a power plant has been installed for lighting and for furnishing the city with water. On the lower course of the Niobrara a number of mills are in operation, receiving their power from small tributaries. On Snake River opportunities for power development are phenomenal, but long transmission lines would be required to make it of practical value.

NIOBRARA RIVER AT NIOBRARA, NEBR.

This station, which is located at the Government wagon bridge spanning the main channel in the SE. ¼ sec. 18, T. 32 N., R. 6 W., half a mile south and half a mile west of the depot at Niobrara and 1½ miles above the junction of Niobrara and Missouri rivers, was established May 11, 1902, discontinued October 25, 1902, and reestablished August 19, 1910. The station is below all tributaries.

[1] See report on Niobrara River basin, by Stevens, J. C., Surface waters of Nebraska: Water-Supply Paper U. S. Geol. Survey No. 230, 1909, pp. 220–238.

A rod gage is fastened to a pile at the southwest end of the Government bridge in the main channel. The location and datum of this gage bear no relation to those of the wire gage used in 1902.

Measurements are made from the Government wagon bridge and from the highway bridge which crosses the west channel three-fourths of a mile west of the gage. The west channel is separated from the main channel by an island for a mile above and below the gage.

The bed of the stream is sandy and shifting, making frequent discharge measurements necessary. There are two channels at high stages and numerous small ones at low stages.

During the winter months gage heights are from time to time affected by ice.

This station is located very near the mouth of the river, and as the fall between the gaging section and Missouri River is small, records will probably be affected by backwater from the Missouri.

Discharge measurements of Niobrara River at Niobrara, Nebr., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 26	D. D. Price	330	335	2.10	1,040
Oct. 9	A. A. Dobson	230	302	1.80	1,000
Nov. 26	....do	590	457	1.50	1,650

Daily gage height, in feet, of Niobrara River at Niobrara, Nebr., for 1910.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.8	1.5	1.8	1.7	16	.....	1.6	1.8	1.7	2.8
2	.....	1.9	1.4	1.8	1.8	17	.....	1.6	1.8	1.7	3.1
3	.....	1.8	1.4	1.7	1.7	18	.....	1.6	1.8	1.7	3.4
4	.....	1.8	1.6	1.7	1.6	19	2.1	1.65	1.8	1.7	3.6
5	.....	1.7	1.8	1.7	1.6	20	2.1	1.6	1.8	1.7	3.2
6	.....	1.7	1.7	1.6	1.7	21	2.2	1.8	1.8	1.7	3.4
7	.....	1.7	1.8	1.6	1.7	22	2.2	1.9	1.9	1.7	3.6
8	.....	1.7	1.8	1.7	1.8	23	2.1	1.9	1.9	1.7	3.8
9	.....	1.7	1.8	1.7	1.8	24	2.1	1.9	1.8	1.6	2.2
10	.....	1.7	1.8	1.6	1.8	25	2.1	1.9	1.8	1.6	.....
11	.....	1.6	1.8	1.7	1.7	26	2.0	1.7	1.8	1.5	.....
12	.....	1.6	1.8	1.7	1.8	27	2.0	1.7	1.8	1.6	.....
13	.....	1.6	1.7	1.8	1.8	28	1.9	1.7	1.8	1.7	.....
14	.....	1.6	1.7	1.8	2.2	29	1.9	1.6	1.8	1.7	.....
15	.....	1.6	1.8	1.7	2.6	30	1.8	1.6	1.7	1.8	.....
						31	1.8	.....	1.8	.....	.....

NOTE.—River frozen Dec. 25.

PLATTE RIVER BASIN.

GENERAL FEATURES.

Considered only with regard to extent of the area drained, the Platte is the most important tributary of the Missouri. It is formed by two forks, North Platte and South Platte, which rise, respectively, in northern and in central Colorado and unite a little southwest of

the center of Nebraska. Its entire drainage basin comprises about 84,000 square miles, of which 28,500 square miles belong to the North Platte and 24,000 to the South Platte. The lower course of the river is fairly well settled, but farther west the population is more scattered.

NORTH PLATTE RIVER AND PLATTE RIVER PROPER.

DESCRIPTION.

The source of North Platte River, here considered the continuation of the main stream, is in North Park, Colo., or rather in the mountains which, rising to elevations from 4,000 to 5,000 feet above its general level, hem it in on all sides. The park is just east of the continental divide, some of the peaks of which in that locality exceed 12,000 feet in altitude. From the steep slopes of the mountains numerous small streams descend, unite below into large creeks, and flow outward to the center of the basin. The two which may be said to form the real head of the North Platte are Grizzly and Little Grizzly creeks, but within the park the river is joined by four large tributaries, Roaring Fork and North Fork from the west and Michigan and Canadian creeks from the east. Leaving the park, the river makes a bold curve northward into Wyoming, but near Casper, on the north side of the Casper Range, it turns abruptly to the east and southeast, maintaining the latter course to its point of junction with the South Platte in central Nebraska.

Within North Park the topographic features are diversified, including every degree of roughness from the snow-capped peaks of the Park and Medicine Bow ranges to the level prairie mesas along the lower portion of the stream. Dense forests cover the mountain tracts, the heaviest being those on the east slope of the Park and the west slope of the Medicine Bow ranges. At an elevation of 8,500 feet above sea level the forests give way to the open prairie country, which, with the exception of the dense growth of willows along the river bottoms, is entirely free from forests of any description.

The soil, composed principally of sandy and gravelly loam on the mesas and of sandy and black loam along the river bottoms, is in general fertile, but climatic conditions are such that the agricultural products are limited to wild hay, roots, and a few of the hardier grains.

In its northward course through Wyoming the stream receives many tributaries, the Snowy Range on the east contributing its drainage through Douglas, French, and Brush creeks, while the northeast slope of the Sierra Madre is drained by Beaver, Big Cow, and Spring creeks and Grand Encampment River. Medicine Bow and Sweetwater rivers are added to the North Platte between Saratoga and Casper,

beyond which the only important tributary is the Laramie, which enters at old Fort Laramie.

The greater part of the region below Saratoga is a rolling, undulating prairie. The soil throughout Wyoming is a sandy loam of sufficient depth to produce meadows of rich grasses, even up to elevations of 7,000 feet. At lower elevations the soil becomes more friable and deeper.

Throughout its course in western Nebraska the valley of the North Platte is 10 to 15 miles wide. The present floor, consisting of sediments deposited in a former greater valley, is bordered by terraces and table-lands scarred by numerous tributaries and arroyos. The stream is broad and shallow, with a flood plain from 1 mile to 4 miles wide.

The character of the river bed at the Big Bend and at the Seminole Mountains, in Wyoming, seems to indicate a considerable underflow. A part of this is collected at the Big Bend, and probably the entire amount is brought to the surface as the river passes through the Seminole Range. In its lower course the bed of the stream is of fine quicksand underlain at a depth of 15 to 20 feet by a hard layer which seems to be clay.

The total length of the river from source to mouth is nearly 650 miles. At Pinkhampton, Colo., it is about 8,000 feet above sea level; at Fort Steele, Wyo., about 500 miles above its mouth, it is 6,500 feet; and at Fort Laramie it is 4,200 feet, and at North Platte, Nebr., 2,800 feet.

The drainage area includes about 28,800 square miles, of which 1,800 square miles are in Colorado, 20,000 in Wyoming, and nearly 7,000 in Nebraska.

In the mountain districts precipitation, usually in the form of snow during the winter and spring months, ranges from 7 to 15 inches, the average being about 11 inches; in the high mountains it is 20 inches and upward. Throughout the lower portion of the basin the precipitation is from 15 to 18 inches, and the evaporation from the water surface is 5 to 6 feet annually.

The stream is subject to periodic floods, which reach the maximum at the mouth some time during the latter part of June and are caused by the melting snow on the high ranges. The river runs lowest in winter and is usually covered with thick ice. High water prevails from the middle of April until the middle of July, during which period the river is frequently bank full.

The winters are quite severe thoughout the basin of this stream, and particularly so above an altitude of 4,000 feet. On the plains areas, although there is considerable snowfall, the snow does not lie for more than a few days at a time.

Agriculture in the basin of the North Platte has been confined largely to the valleys of the tributaries, and most of the available agricultural lands on these tributaries are now occupied. At present irrigation is most extensively practiced on Laramie and Little Laramie rivers in the vicinity of Laramie; on the Laramie in the vicinity of Wheatland, and on the North Platte itself for a considerable distance on both sides of the Wyoming-Nebraska line.

The Laramie-Poudre project will divert a considerable portion of the flow of Laramie River in Colorado across the divide by means of a tunnel into the headwaters of the Cache la Poudre, where the waters will be used to irrigate land in the South Platte drainage. Construction is well along on this project. The nearly completed North Platte project of the Reclamation Service will provide for the irrigation of about 100,000 acres of land along the North Platte in Nebraska and Wyoming. Numerous other irrigation projects are contemplated or are in course of construction, and many additional opportunities for development by storage of flood waters still remain.

The basin contains many excellent reservoir sites, a few of which have been developed. The most notable is the Pathfinder reservoir of the United States Reclamation Service. This reservoir, with a dam 215 feet high, has a capacity of over 1,000,000 acre-feet. Another excellent site is at what is usually known as the "Devils Gate" on Sweetwater River a few miles above its mouth. It has a capacity of over 300,000 acre-feet, but has never been developed on account of the inadequacy of the water supply; and as the Pathfinder reservoir will store the flood waters of the Sweetwater it is not likely that the Devils Gate reservoir will ever be built. On the North Platte and its tributaries in Colorado are several fairly good reservoir sites, the largest being on the North Platte near Pinkhampton, which would have a capacity of nearly 100,000 acre-feet with a dam 100 feet high. The reservoir site on Laramie River near Glendevey, Colo., has a capacity of about 15,000 acre-feet.

Power development on the North Platte will be limited largely to the upper river and its tributaries and probably never will be in excess of 50,000 horsepower. Present development amounts to only a few hundred horsepower.

The more recent records of the United States Geological Survey indicate 1902 as the driest and 1909 as the wettest year.

From the point of junction of North and South Platte rivers the main stream winds eastward across Nebraska for over 200 miles, uniting with the Missouri at Plattsmouth, about 10 miles south of Omaha. Its course lies chiefly through broad, level bottom lands, rather sandy in places, but for the most part fertile, bordered by bluffs ranging in height from 50 to 400 feet. To a point near

Ashland, Saunders County, it is a broad, shallow stream, flowing in many places as a network of interlacing channels among numerous islands and sand bars, but farther east it is confined between heavily wooded limestone bluffs. The average fall is about 6 feet per mile.

The average annual precipitation is about 23 inches, of which 69 per cent falls during the five months of the growing season, from April to August; about one-half of the remainder is snowfall. The evaporation averages about 4½ feet. The stream is subject to periodic floods caused by melting of snows in the headwaters regions of North and South Platte rivers. These floods reach a maximum in June and July and often do considerable damage to property on the lower portions of the stream. In the western part of the drainage area the waters of the stream are extensively used for irrigation.

The records of the Survey indicate 1905 and 1909 as years of high water, and 1902 and 1908 as low-water years.

The following special reports contain information regarding the hydrography of Colorado and Nebraska:

Water resources of Colorado by A. L. Fellows, 1902: Water-Supply Paper U. S. Geol. Survey No. 74. Surface waters of Nebraska, by J. C. Stevens, 1909: Water-Supply Paper U. S. Geol. Survey No. 230.

NORTH PLATTE RIVER AT PATHFINDER, WYO.

This station, which is located one-half mile south of Pathfinder post office and 500 feet below the mouth of the canyon, in sec. 24, T. 29 N., R. 84 W., sixth principal meridian, Wyoming, was established May 9, 1905, and has been maintained by the United States Reclamation Service to show the amount of water available for storage in connection with the North Platte project.

The Pathfinder reservoir is about one-fourth mile above the station, which is at an elevation of nearly 5,700 feet, and Sweetwater River enters the North Platte about 3 miles above. The drainage area is about 12,000 square miles.

Very little water is diverted above the station. Some land is irrigated on the North Platte and its tributaries, but opportunities for much additional development can be found.

The datum of the gage has remained constant during the maintenance of the station. The flow is affected by ice for several months during the winter season. The results obtained at this station have been on the whole very satisfactory.

Discharge measurements of North Platte River at Pathfinder, Wyo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 11[a]	L. V. Branch	165	595	2.00	448
Apr. 21	Comstock and Ralston	185	665	2.12	655
May 31	.....do	193	755	2.66	958
June 23	.....do	198	1,150	4.06	2,380

[a] Ice.

Daily gage height, in feet, of North Platte River at Pathfinder, Wyo., for 1910.

[J. C. Ralston, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.85	1.8	1.8	3.3	2.4	3.3	4.15	3.75	3.7	1.6	2.0	1.35
2	1.85	1.85	2.1	3.2	2.35	3.8	4.1	3.75	3.8	1.25	1.9	1.35
3	2.0	1.8	2.4	3.25	2.4	3.8	4.05	3.75	3.5	.85	1.9	1.35
4	2.0	1.8	2.7	3.15	2.4	3.55	4.05	3.75	3.55	1.4	1.9	3.1
5	2.0	1.75	3.0	3.3	2.4	3.9	4.05	3.75	3.6	1.45	1.9	1.2
6	2.0	1.8	3.0	3.3	2.4	3.9	4.0	3.75	3.7	1.4	1.8	1.25
7	1.95	1.75	3.25	3.25	2.45	4.9	4.0	3.7	3.7	1.45	1.85	1.25
8	2.0	1.7	3.4	3.2	2.45	4.4	4.15	3.7	3.7	1.4	1.85	1.25
9	1.95	1.7	3.55	2.95	2.45	4.5	4.1	3.7	3.55	1.35	1.8	1.25
10	1.95	1.65	3.75	2.9	2.45	4.5	3.95	3.7	3.55	1.0	1.75	1.25
11	2.0	1.65	3.6	3.1	2.45	4.4	3.85	3.7	3.55	1.1	1.7	1.3
12	2.0	1.65	3.9	3.2	2.45	4.4	3.8	3.7	3.7	1.15	1.7	1.3
13	2.0	1.6	3.95	3.55	2.5	4.45	3.8	3.7	3.7	1.15	1.75	1.3
14	1.95	1.6	4.05	4.1	2.5	4.45	3.8	3.7	3.7	1.2	1.75	1.3
15	1.9	1.6	3.7	1.8	2.5	4.4	3.7	3.7	3.65	1.4	1.7	2.9
16	1.9	1.8	3.5	4.3	2.5	4.3	3.7	3.7	3.75	1.45	1.65	2.9
17	2.0	1.8	3.5	1.9	2.5	4.35	3.7	3.7	3.7	1.45	1.65	1.25
18	1.9	1.8	3.5	2.0	2.5	4.05	3.7	3.7	3.7	1.5	1.3	1.3
19	2.0	1.8	3.5	2.0	2.5	4.05	3.7	3.65	3.65	1.6	1.2	1.3
20	1.9	1.7	3.6	2.1	2.5	4.05	3.7	3.65	3.65	1.8	1.15	1.3
21	1.9	1.75	3.7	2.1	2.55	4.05	3.7	3.7	3.7	2.0	1.15	1.3
22	1.9	1.95	3.85	2.1	2.6	4.05	3.85	3.7	3.65	3.3	1.2	1.3
23	1.9	1.7	3.95	2.15	2.6	4.05	3.85	3.7	3.6	2.2	1.3	1.3
24	1.85	1.65	4.05	2.2	2.6	4.0	3.85	3.8	3.6	2.6	1.3	1.3
25	1.85	1.6	4.2	2.2	2.6	4.05	3.85	3.8	3.55	2.2	1.35	1.3
26	1.8	1.7	4.25	2.2	2.55	4.1	3.8	3.8	3.45	2.25	1.3	1.3
27	1.8	1.7	4.15	2.2	2.55	4.1	3.8	3.75	3.45	1.7	1.3	1.3
28	1.8	1.75	4.05	2.3	2.55	4.1	3.8	3.75	3.45	1.85	1.35	1.3
29	1.7	.....	3.9	2.3	2.6	4.0	3.8	3.7	1.7	1.9	1.3	1.3
30	2.0	.....	3.7	2.3	2.65	4.05	3.75	3.7	1.65	1.85	1.3	1.3
31	1.8	.....	3.55	.....	.....	.....	3.75	3.7	.....	1.95	.....	1.3

NOTE.—Ice Jan. 1 to Mar. 5. Ice 15 inches thick at gage Feb. 10, 14 inches thick Feb. 26, some water on top of ice Mar. 1, ice gone out at station Mar. 6. The gage heights are affected by gate regulation at Pathfinder dam. Known dates when gage heights were so affected are: Jan. 29–31, July 21, Aug. 24, Sept. 5, Oct. 2, 4, 22–25, Nov. 17, Dec. 4, 5, 16, and 17.

Daily discharge, in second-feet, of North Platte River at Pathfinder, Wyo., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	403	388	388	1,520	820	1,520	2,420	1,980	1,920	438	615	334
2	403	403	480	1,440	790	2,030	2,360	1,980	2,030	294	569	334
3	448	388	610	1,480	820	2,030	2,300	1,980	1,720	185	569	334
4	448	388	760	1,390	820	1,760	2,300	1,980	1,760	354	569	1,340
5	448	373	960	1,520	820	2,140	2,300	1,980	1,820	375	569	276
6	448	388	1,260	1,520	820	2,140	2,250	1,980	1,920	354	525	294
7	433	373	1,480	1,480	850	3,330	2,250	1,920	1,920	375	547	294
8	448	359	1,620	1,440	850	2,700	2,420	1,920	1,920	354	547	294
9	433	359	1,760	1,220	850	2,820	2,360	1,920	1,760	334	525	294
10	433	344	1,980	1,180	850	2,820	2,200	1,920	1,760	214	503	294

Daily discharge, in second-feet, of North Platte River at Pathfinder, Wyo., for 1910—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	448	344	1,820	1,340	850	2,700	2,080	1,920	1,760	243	481	313
12	448	344	2,140	1,440	850	2,700	2,030	1,920	1,920	260	481	313
13	448	330	2,200	1,760	880	2,760	2,030	1,920	1,920	260	503	313
14	433	330	2,300	2,360	880	2,760	2,030	1,920	1,920	276	503	313
15	418	330	1,920	525	880	2,700	1,920	1,920	1,870	354	481	1,180
16	418	388	1,720	2,580	880	2,580	1,920	1,920	1,980	375	460	1,180
17	448	388	1,720	569	880	2,640	1,920	1,920	1,920	375	460	294
18	418	388	1,720	615	880	2,300	1,920	1,920	1,920	396	313	313
19	448	388	1,720	615	880	2,300	1,920	1,870	1,870	438	276	313
20	418	359	1,820	661	880	2,300	1,920	1,870	1,870	525	260	313
21	418	373	1,920	661	915	2,300	1,920	1,920	1,920	615	260	313
22	418	433	2,080	661	950	2,300	2,080	1,920	1,870	1,520	276	313
23	418	359	2,200	686	950	2,300	2,080	1,920	1,820	710	313	313
24	403	344	2,300	710	950	2,250	2,080	2,030	1,820	950	313	313
25	403	330	2,470	710	950	2,300	2,080	2,030	1,760	710	334	313
26	388	359	2,520	710	915	2,360	2,030	2,030	1,660	735	313	313
27	388	359	2,420	710	915	2,360	2,030	1,980	1,660	481	313	313
28	388	373	2,300	760	915	2,360	2,030	1,980	1,660	547	334	313
29	359	.....	2,140	760	950	2,250	2,030	1,920	481	569	313	313
30	448	.....	1,920	760	985	2,300	1,980	1,920	460	547	313	313
31	388	.....	1,760	.....	1,000	.....	1,980	1,920	.....	592	.....	313

NOTE.—These discharges are based on rating curves applicable as follows: Jan. 1 to Mar. 5, ice curve defined by measurement of Jan. 11, 1910, Mar. 6 to Dec. 31 (computations for this period made by U. S. Reclamation Service), well defined.

Monthly discharge of North Platte River at Pathfinder, Wyo., for 1910.

[Drainage area, 12,000 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	448	350	423	0.035	0.04	26,000	D.
February	433	330	367	.031	.03	20,400	D.
March	2,520	388	1,760	.147	.17	108,000	B.
April	2,580	525	1,130	.094	.10	67,200	A.
May	[a] 1,000	790	885	.074	.09	54,400	A.
June	3,330	1,520	2,400	.200	.22	143,000	A.
July	2,420	1,920	2,100	.175	.20	129,000	A.
August	2,030	1,870	1,940	.162	.19	119,000	A.
September	2,030	460	1,750	.146	.16	104,000	A.
October	1,520	185	476	.040	.05	29,300	B.
November	615	260	428	.036	.04	25,500	B.
December	1,340	276	399	.033	.04	24,500	C.
The year	3,330	260	1,180	.098	1.33	850,000	

[a] Estimated.

Inflow, in second-feet, into Pathfinder reservoir at Pathfinder, Wyo., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	388	1,440	4,500	5,310	836	423	247
2	480	1,410	5,500	8,140	430	423	252
3	610	1,550	3,810	6,940	368	387	287
4	760	1,370	4,610	6,790	414	387	287
5	960	1,440	3,680	6,940	464	380	388
6	1,300	1,700	3,260	5,820	363	368	444
7	1,500	1,500	3,450	5,000	414	363	444
8	1,630	1,460	3,650	5,210	580	363	439
9	1,920	1,210	3,550	4,910	525	262	434
10	1,800	1,440	3,300	4,000	404	262	434

Inflow, in second-feet, into Pathfinder reservoir at Pathfinder, Wyo., for 1910—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
11	2,010	1,330	3,190	2,280	297	262	434
12	1,840	1,510	3,960	2,280	293	257	439
13	2,500	1,610	3,490	3,150	293	257	283
14	2,350	2,300	3,740	3,150	293	257	333
15	1,600	2,210	5,100	3,140	276	257	328
16	1,620	2,000	5,150	3,000	276	207	338
17	1,720	2,470	5,800	2,640	400	207	378
18	1,720	2,380	5,560	2,790	400	207	378
19	1,770	2,020	4,600	2,340	400	353	368
20	1,860	1,980	4,100	2,340	400	353	368
21	2,050	2,640	4,490	1,890	345	353	424
22	2,150	2,440	3,660	1,480	405	353	414
23	2,250	2,570	3,610	1,530	350	202	414
24	2,450	2,310	3,610	1,430	400	207	414
25	2,550	3,360	3,410	1,070	450	207	409
26	2,650	3,480	3,690	1,230	445	106	409
27	2,150	2,920	3,650	720	450	100	343
28	2,000	3,130	4,200	1,020	450	101	343
29	1,800	3,240	3,900	1,070	475	100	328
30	1,800	3,440	4,220	720	475	139	459
31	1,610	.....	4,920	.....	475	200	.....

NOTE.—These daily discharges were computed by the United States Reclamation Service and are published without change.

Monthly inflow into Pathfinder reservoir at Pathfinder, Wyo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
March	2,650	388	1,740	107,000
April	3,480	1,210	2,130	127,000
May	5,800	3,190	4,110	253,000
June	8,140	720	3,280	195,000
July	836	276	414	25,500
August	423	100	268	16,500
September	459	247	375	22,300
The period	.....	.....	.....	746,000

NOTE.—These estimates were furnished by the United States Reclamation Service. They have been slightly changed to conform to the computation rules of the United States Geological Survey.

NORTH PLATTE RIVER AND INTERSTATE CANAL AT WHALEN, WYO.

This station, which is located at the head of the Interstate canal at Whalen, Wyo., about 7 miles below Guernsey, was established May 1, 1909, by the United States Reclamation Service at the recently completed Whalen weir, to obtain data on stream flow for use in connection with the North Platte project and to replace the station on the North Platte at Guernsey.

No important tributaries enter the river for several miles above; Laramie River comes in about 6 miles below the station.

The zero of the weir gage is the level of the weir crest, which is 300 feet wide. The discharges given in the table for the river station include the flow over the weir, the flow through the four scour gates in the weir, which are $5\frac{3}{4}$ feet wide and 6 feet high when fully opened, and the discharge through the nine diversion gates of the Interstate canal, which are the same size as the sluiceway gates.

Another river gage is fastened to the retaining wall 75 feet downstream from the weir crest. The zero of the gage is 10 feet below the zero of the weir gage.

The canal gage is painted on the retaining wall about 1,000 feet below the diversion gate; its zero is on a level with canal bottom.

The readings of the river and canal gages have been used only when it has been necessary to compute the discharges through the gates when the gate openings are submerged.

The weir and discharge coefficients have been rather uncertain, and it is the intention eventually to check them up by a series of meter measurements of the canal and the river. During the spring of 1910 a gage and cable were installed at a point about 1 mile downstream from the weir, and several meter measurements were taken during the season, but the record is not complete enough to furnish convincing evidence as to the coefficients.

The seven diversion gates of the proposed Fort Laramie canal are the same size as those of the Interstate canal, and are situated at the south end of the Whalen weir. This canal has not yet been constructed.

The 1910 data for these stations are published as furnished by the United States Reclamation Service.

Discharge measurements of North Platte River at Whalen, Wyo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 27	W. T. Ferguson	286	745	1.90	571
31	do	280	620	1.50	361
June 5	Freeman and Pyle	295	895	2.45	913
10	W. T. Ferguson	300	1,090	3.10	1,770
July 15	do	292	811	2.18	783
Aug. 15	do	285	723	1.97	597
Sept. 5		284	685	1.72	438

Daily discharge, in second-feet, of North Platte River at Whalen, Wyo., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	703	642	740	2,666	1,409	1,044	2,111	1,895	1,716	1,711	765	418
2	643	578	908	2,558	1,409	970	2,141	1,831	1,716	1,654	765	418
3	650	578	1,223	2,451	1,344	1,086	2,174	1,773	1,716	1,056	765	470
4	635	642	1,489	2,344	1,286	1,418	2,128	1,773	1,721	893	765	521
5	620	642	3,056	2,241	1,333	1,860	2,296	1,773	1,530	700	765	521
6	615	642	2,384	2,138	1,268	1,835	2,181	1,773	1,530	636	765	330
7	590	642	1,577	2,040	1,268	1,732	2,104	1,773	1,530	636	765	374
8	590	578	1,668	2,040	1,275	1,835	2,158	1,826	1,530	578	765	906
9	590	578	1,760	2,040	1,261	2,187	2,127	1,801	1,618	521	765	765
10	590	642	1,854	2,040	1,225	2,172	1,990	1,801	1,669	521	700	418
11	590	642	1,854	1,941	1,143	2,225	2,045	1,748	1,669	469	700	418
12	590	642	1,947	2,138	1,105	2,491	2,023	1,763	1,618	469	700	469
13	590	578	2,144	1,941	1,054	2,521	1,951	1,763	1,618	469	700	374
14	590	578	2,045	2,138	1,044	2,531	1,891	1,763	1,618	418	700	259
15	590	578	2,144	2,666	1 070	2,576	1,836	1,768	1,669	418	700	330
16	590	642	2,350	2,774	1,084	2,611	1,836	1.711	1,721	418	700	294
17	590	642	2,457	2,843	1,119	2,554	1,846	1.711	1,778	418	636	259
18	645	642	2,247	2,588	1,160	2,467	1,782	1,716	1,721	636	636	259
19	674	642	2,144	3,191	1,238	2,379	1,628	1,716	1,965	579	636	330
20	622	642	2,045	2,364	1,258	2,313	2,593	1,716	1,778	1,305	636	374

Daily discharge, in second-feet, of North Platte River at Whalen, Wyo., for 1910—Concluded.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	710	642	2,045	2,091	1,331	2,158	2,131	1,664	1,778	1,865	765	765
22	776	642	2,144	2,091	1,263	2,026	2,290	1,664	1,778	1,061	765	521
23	850	531	2,247	2,091	1,263	1,970	2,054	1,664	1,836	835	636	418
24	850	554	2,475	2,091	1,216	1,980	2,036	1,664	1,836	765	578	374
25	707	590	2,780	2,008	1,183	1,980	1,895	1,664	1,778	765	521	294
26	707	590	2,780	1,832	1,183	1,980	1,830	1,664	1,721	1,398	521	294
27	707	643	2,889	1,832	1,183	1,965	1,766	1,716	1,669	1,142	521	294
28	707	669	3,001	1,754	1,183	1,968	1,766	1,773	1,669	1,061	470	234
29	642	.....	3,114	1,820	1,183	1,919	1,806	1,773	1,652	906	418	259
30	642	.....	3,114	1,521	1,184	1,928	1,773	1,773	1,615	835	418	374
31	642	.....	2,774	.....	1,104	.....	2,423	1,716	.....	765	.....	418

NOTE.—These discharges were computed by the United States Reclamation Service and are published herewith unchanged. They have not been verified by engineers of the United States Geological Survey. The discharges in this table include the discharge of the Interstate canal and the flow over the river weir and sluices.

Monthly discharge of North Platte River at Whalen, Wyo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January	850	590	653	40,200
February	669	531	616	34,200
March	3,110	740	2,170	133,000
April	3,190	1,520	2,210	132,000
May	1,410	1,040	1,210	74,400
June	2,610	970	2,020	120,000
July	2,590	1,630	2,020	124,000
August	1,900	1,660	1,750	108,000
September	1,960	1,530	1,690	101,000
October	1,860	418	836	51,400
November	765	418	665	39,600
December	906	234	411	25,200
The year	3,190	234	1,360	983,000

NOTE.—These estimates were computed by the United States Geological Survey from data furnished by the United States Reclamation Service, published herewith, and include the total flow in the river and Interstate canal.

Daily discharge, in second-feet, of Interstate canal at Whalen, Wyo., for 1910.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	528	788	1,205	1,195	1,195	1,711
2	.....	528	714	1,080	1,195	1,195	430
3	.....	528	750	0	1,195	1,195	120
4	.....	470	780	57	1,195	1,200	315
5	.....	452	875	420	1,195	1,200	.....
6	.....	452	850	690	1,195	1,200	.....
7	.....	452	895	960	1,195	1,200	.....
8	.....	459	850	1,095	1,190	1,200	.....
9	.....	503	960	727	1,165	1,200	.....
10	.....	524	945	1,005	1,165	1,200	.....
11	.....	548	1,080	1,060	1,170	1,200	.....
12	.....	554	1,090	1,115	1,185	1,200	.....
13	.....	550	1,120	1,115	1,185	1,200	.....
14	.....	575	1,130	1,125	1,185	1,200	.....
15	.....	601	1,175	1,136	1,190	1,200	.....
16	.....	615	1,210	1,136	1,190	1,200	.....
17	177	615	1,240	1,146	1,190	1,200	.....
18	341	612	1,240	1,146	1,195	1,200	.....
19	417	643	1,235	1,030	1,195	1,200	.....
20	420	313	1,250	1,008	1,195	1,200	.....

Daily discharge, in second-feet, of Interstate canal at Whalen, Wyo., for 1910—Contd.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
21	422	630	1,250	1,146	1,195	1,200	.....
22	422	668	1,260	1,146	1,195	1,200	.....
23	422	712	1,270	1,146	1,195	1,200	.....
24	422	712	1,280	1,130	1,195	1,200	.....
25	427	714	1,280	1,130	1,195	1,200	.....
26	425	714	1,280	1,130	1,195	1,200	.....
27	425	714	1,200	1,130	1,195	1,200	.....
28	425	714	0	1,130	1,195	1,200	.....
29	491	714	150	1,170	1,195	1,074	.....
30	473	751	702	1,195	1,195	780	.....
31	.....	797	.....	1,195	1,195	.....	.....

NOTE.—These discharges were computed by the United States Reclamation Service from their weir and canal gage readings and are published herewith unchanged. They have not been verified by engineers of the United States Geological Survey. There was no flow Jan. 1 to Apr. 16, and Oct. 6 to Dec. 31.

Monthly discharge of Interstate canal at Whalen, Wyo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January	.....	.....	0	0
February	.....	.....	0	0
March	.....	.....	0	0
April	491	0	190	11,300
May	797	313	592	36,400
June	1,280	0	995	59,200
July	1,200	0	997	61,300
August	1,200	1,160	1,190	73,200
September	1,200	780	1,180	70,200
October	1,710	0	92.8	5,710
November	.....	.....	0	0
December	.....	.....	0	0
The year	1,710	0	439	317,000

NOTE.—These estimates were computed by the United States Geological Survey from data furnished by the United States Reclamation Service published herewith.

NORTH PLATTE RIVER NEAR MITCHELL, NEBR.

This station, which was established June 3, 1901, to replace the station at Gering, is located at a highway bridge 1 mile south of Mitchell, Nebr., in sec. 27, T. 23 N., R. 56 W. The records at this point show the amount of water passing the Wyoming-Nebraska State line, and are of especial value in connection with interstate questions concerning the distribution of water. Laramie River and Rawhide Creek enter the river in Wyoming below the Guernsey station, and Horse Creek comes in just below the State line. No important tributaries enter below the station. Important diversions for irrigation are made both above and below the station.

The chain gage is fastened to the upstream handrail of the pile bridge from which discharge measurements are usually made. The datum of the gage was lowered 1 foot May 3, 1902, to obviate negative readings. As the river sometimes freezes solid, few records have been obtained during the winter.

As the bed of the river is of shifting sand, and the measurements are insufficient in number to indicate all changes, the results obtained are unsatisfactory.

This station was discontinued October 6, 1910.

Discharge measurements of North Platte River near Mitchell, Nebr., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 20	D. D. Price	980	1,150	3.10	2,640
Apr. 29	do	860	732	2.80	1,530
June 1	R. H. Willis	497	186	1.90	215
23	E. C. Simmons	728	316	2.20	409
July 28	R. H. Willis	263	93	1.65	120
Nov. 29	do	679	371	2.35	687

Daily gage height, in feet, of North Platte River near Mitchell, Nebr., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	3.0	3.2	.....	2.2	2.3	1.8	1.4	2.1
2	2.7	3.2	2.8	2.1	2.4	2.3	1.4	.....
3	2.7	.....	2.8	2.1	.....	2.0	1.4	2.4
4	2.7	3.4	2.7	2.1	2.8	1.8	.....	2.4
5	2.7	3.3	2.7	.....	2.7	1.7	1.4	2.3
6	.....	3.1	2.7	2.1	2.7	1.7	1.4	.....
7	3.2	3.3	2.7	2.1	2.5	.....	1.4	.....
8	3.0	3.3	.....	1.9	2.4	1.7	1.4	.....
9	3.0	3.3	2.5	1.9	2.3	1.7	1.4	.....
10	2.9	.....	2.4	2.0	.....	1.6	1.6	.....
11	2.9	3.0	2.4	2.2	2.3	1.6	.....	.....
12	3.0	3.0	2.4	.....	2.3	1.6	1.6	.....
13	.....	3.1	2.3	2.3	2.2	1.6	1.6	.....
14	3.2	3.1	2.3	2.5	2.0	.....	2.0	.....
15	3.1	3.1	.....	2.6	1.8	1.6	2.0	.....
16	3.0	3.2	2.3	2.6	1.8	1.6	1.7	.....
17	3.0	.....	2.3	2.5	.....	1.5	1.7	.....
18	3.1	3.2	2.3	2.5	1.7	1.5	.....	.....
19	3.1	3.1	2.3	.....	1.7	1.5	1.7	.....
20	.....	3.2	2.3	2.4	2.0	1.5	1.7	.....
21	3.1	3.1	2.3	2.4	2.1	.....	1.8	.....
22	3.1	3.0	.....	2.4	2.3	1.5	1.8	.....
23	3.1	3.0	2.3	2.4	1.9	1.5	1.9	.....
24	3.1	.....	2.3	2.2	.....	1.4	2.0	.....
25	3.0	2.9	2.3	2.2	1.7	1.4	.....	.....
26	3.1	3.0	2.3	.....	1.7	1.4	2.0	.....
27	.....	3.0	2.3	1.9	1.7	1.4	2.0	.....
28	3.2	2.9	2.2	1.9	1.7	.....	1.9	.....
29	3.3	2.9	.....	1.9	1.8	1.5	2.0	.....
30	3.3	2.7	2.2	2.6	1.8	1.4	2.0	.....
31	3.2	.....	2.2	.....	.....	1.4	.....	.....

NOTE.—Ice probably existed during January and February.

Daily discharge, in second-feet, of North Platte River near Mitchell, Nebr., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	2,230	2,930	1,480	440	580	170	85	340
2	1,360	2,930	1,620	340	740	580	85	540
3	1,360	3,320	1,620	340	1,180	265	85	740
4	1,360	3,700	1,360	340	1,620	170	85	740
5	1,360	3,310	1,360	340	1,360	135	85	580
6	2,140	2,570	1,360	340	1,360	135	85	.....
7	2,930	3,310	1,360	340	920	135	85	.....
8	2,230	3,310	1,140	215	740	135	85	.....
9	2,230	3,310	920	215	580	135	85	.....
10	1,910	2,770	740	265	580	110	110	.....

Daily discharge, in second-feet, of North Platte River near Mitchell, Nebr., for 1910— Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept	Oct.
11	1,910	2,230	740	440	580	110	110	.....
12	2,230	2,230	740	510	580	110	110	.....
13	2,580	2,570	580	580	440	110	110	.....
14	2,930	2,570	580	920	265	110	265	.....
15	2,570	2,570	580	1,140	170	110	265	.....
16	2,230	2,930	580	1,140	170	110	135	.....
17	2,230	2,930	580	920	152	95	135	.....
18	2,570	2,930	580	920	135	95	135	.....
19	2,570	2,570	580	830	135	95	135	.....
20	2,570	2,930	580	740	265	95	135	.....
21	2,570	2,570	580	740	340	95	170	.....
22	2,570	2,230	580	740	580	95	170	.....
23	2,570	2,230	580	740	215	95	215	.....
24	2,570	2,070	580	440	175	85	265	.....
25	2,230	1,910	580	440	135	85	265	.....
26	2,570	2,230	580	328	135	85	265	.....
27	2,750	2,230	580	215	135	85	265	.....
28	2,930	1,910	440	215	135	90	215	.....
29	3,310	1,910	440	215	170	95	265	.....
30	3,310	1,360	440	1,140	170	85	265	.....
31	2,930	.....	440	.....	170	85	.....	.....

NOTE.—These discharges are based on a well-defined rating curve below 4,000 second-feet. Discharges interpolated for days on which gage was not read.

Monthly discharge of North Platte River near Mitchell, Nebr., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	3,310	1,360	2,380	146,000	A.
April	3,700	1,360	2,620	156,000	A.
May	1,620	440	803	49,400	A,
June	1,140	215	551	32,800	A.
July	1,620	135	481	29,600	B.
August	580	80	129	7,930	B.
September	265	80	159	9,460	B.
The period	.....	.....	.....	431,000	

NORTH PLATTE RIVER AT NORTH PLATTE, NEBR.

This station was originally established October 5, 1894, at the Union Pacific Railroad bridge 2 miles east of North Platte, Nebr., and above the junction of North and South Platte rivers. On April 10, 1910, it was moved to the highway bridge 3½ miles above the confluence of the two forks, about one-half mile north of North Platte, Nebr., in sec. 28, T. 14 N., R. 30 W.

Many diversions are made between the station near Mitchell and the measuring station. One small tributary, Birchwood Creek, maintains a small flow of water at the measuring section at times when the river itself would otherwise be dry.

From October 5, 1894, to May 31, 1910, a vertical gage was used, attached to a cofferdam surrounding the east pier of the Union Pacific Railroad bridge. Because of the stony eddies around

the gage that vitiated the accuracy of the readings, a chain gage was installed March 25, 1910, at a different datum at the highway bridge 2 miles above, and on April 10, 1910, gage readings were commenced. This gage was stolen and the gage record interrupted from July 1 to October 1; on October 15, 1910, a new staff gage was set at the highway bridge at a different datum.

All discharge measurements have been made at the highway bridge.

The datum of the gage at the railroad bridge remained unchanged during the time it was in use.

During the winter the river often freezes solid, as it is very shallow.

Records at this station show the amount of water contributed by the North Platte to the Platte below all diversions. They are subject to the same limitations of shifting channel and poor measuring conditions as other stations on the river, though to a somewhat less degree.

Discharge measurements of North Platte River at North Platte, Nebr., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gauge height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 25	D. D. Price	2,210	1,300	[a] 3.60	3,010
Apr. 26	do	1,180	1,230	[a] 3.40	2,600
May 26	R. H. Willis	774	[a] 523	[a] 3.00	749
Oct. 15	A. A. Dobson	370	176	[b] 2.60	228
Nov. 19	do	576	533	[b] 3.14	963
Dec. 10	do	415	309	[b] 3.45	595

[a] These measurements were taken at the highway bridge 2 miles above the Union Pacific Railroad bridge. The gage heights are the observer's readings at the railroad bridge, as the hydrographer read only the gage at the highway bridge.

[b] These gage heights are from a new gage established Oct. 15, 1910, at highway bridge at a different datum.

Daily gage height, in feet, of North Platte River at North Platte, Nebr., for 1910 (highway bridge gage).

Day.	Apr.	May.	June.	Oct.	Nov.	Dec.	Day.	Apr.	May.	June.	Oct.	Nov.	Dec.
1	.....	3.6	2.9	.....	3.0	3.3	16	3.6	3.0	2.0	.....	3.1	3.5
2	.....	3.6	2.6	.....	3.1	3.25	17	.....	2.9	2.4	2.6	3.2	3.6
3	.....	3.7	2.6	.....	3.15	3.2	18	3.6	3.0	2.2	2.65	3.2	.....
4	.....	3.6	2.6	.....	3.2	.....	19	3.5	2.9	.....	2.6	3.2	3.7
5	.....	3.5	.....	.....	3.2	3.15	20	3.6	2.9	2.1	2.6	.....	3.7
6	.....	3.6	2.5	.....	.....	3.2	21	3.6	2.7	2.0	2.6	3.2	3.6
7	.....	3.6	2.6	.....	3.15	3.25	22	3.7	.....	2.0	2.6	3.2	3.6
8	.....	3.5	2.7	.....	3.1	3.2	23	3.6	2.9	2.0	2.6	3.3	3.5
9	.....	3.4	2.4	.....	3.1	3.15	24	.....	2.9	2.0	2.6	3.3	3.5
10	3.8	3.2	2.4	.....	3.1	3.1	25	3.6	2.9	2.6	2.6	3.3	.....
11	3.7	3.2	2.4	.....	3.1	.....	26	3.4	2.95	.....	2.6	3.4	3.4
12	3.6	3.1	2.0	.....	3.1	3.3	27	3.4	3.1	2.4	2.6	.....	3.4
13	3.7	3.0	2.3	.....	.....	3.3	28	3.4	3.2	2.4	2.65	3.3	3.4
14	3.7	3.0	2.2	.....	3.1	3.4	29	3.4	.....	2.1	2.9	3.25	3.3
15	3.8	.....	2.1	2.6	3.1	3.4	30	3.3	2.8	2.1	.....	3.2	.....
							31	.....	.....	.....	2.95	.....	.....

NOTE.—Gage readings from Apr. 10 to June 30 observed from gage at highway bridge, 2 miles above Union Pacific Railroad bridge. New gage established Oct. 15 at highway bridge, but at different datum. River frozen over Dec. 30.

Daily gage height, in feet, of North Platte River near North Platte, Nebr., for 1910 (railroad bridge gage).

Day.	Mar.	Apr.	May.	Day.	Mar.	Apr.	May.	Day.	Mar.	Apr.	May.
1	3.3	2.5	2.35	11	1.9	2.4	2.4	21	2.0	2.5	2.25
2	3.3	2.5	2.4	12	1.8	2.4	2.4	22	2.0	2.5	2.3
3	3.0	2.5	2.45	13	2.0	2.5	2.35	23	2.0	2.45	2.3
4	3.25	2.5	2.45	14	2.0	2.5	2.35	24	2.0	2.5	2.3
5	3.5	2.5	2.55	15	2.0	2.5	2.3	25	2.1	2.5	2.3
6	2.5	2.5	2.6	16	2.0	2.4	2.3	26	2.1	2.45	2.25
7	2.0	2.5	2.6	17	2.1	2.4	2.25	27	2.2	2.45	2.25
8	2.0	2.5	2.5	18	2.0	2.45	2.25	28	2.2	2.4	2.25
9	1.95	2.5	2.5	19	2.0	2.4	2.25	29	2.3	2.4	2.3
10	1.9	2.5	2.4	20	2.0	2.4	2.25	30	2.3	2.4	2.3
								31	2.3	.....	2.3

NOTE.—Ice January, February, Mar. 1 to about Mar. 6. Ice breaking up Mar. 3.

PLATTE RIVER NEAR COLUMBUS, NEBR.

This station, which was established June 4, 1895, and has been kept continuously since that date except during the winter months, is located above the mouth of Loup River, at Meridian Bridge, about 3 miles south of Columbus, in sec. 31, T. 17 N., R. 1 E. No important tributaries enter the river between the junction of the North Platte and the South Platte and this station, and Loup River and Elkhorn River are the only large tributaries below. The drainage area is 56,900 square miles.

In the late summer practically all the water of the river disappears, either from diversion or evaporation from the wide shallow channels. No records have been obtained during the ice period of the winter.

The bed of the river is of shifting sand and at low water the stream flows in many shallow channels, so that determination of discharge is largely a matter of estimate. Poor measuring conditions, combined with shifting channel, render the records liable to considerable error. The gage datum has remained the same throughout.[1]

The river at this point flows in three channels, known as the main, middle, and south channels, respectively, each of which is spanned by a pile bridge from the upstream side of which discharge measurements are made. The chain gage is fastened to the upstream side of the main channel bridge, which is called the Meridian Bridge, and has a span of nearly 2,000 feet. The middle channel bridge is over 300 feet long, and the south channel bridge is about 80 feet long.

The gage was destroyed with the bridge early in season of 1910. On July 25, 1910, it was reestablished in the same place, but possibly at a slightly different datum.

[1] Data collected at this station prior to 1908 have been compiled in Water-Supply Paper 230 : Surface water supply of Nebraska.

Discharge measurements of Platte River at Columbus, Nebr., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 25	A. A. Dobson				[a] 0
Oct. 1	do			0.55	[b] 10
Nov. 19	do				[c] 0
25	do			.48	[b] 28

[a] River dry. [b] Estimated. [c] Water standing in pools which were frozen over.

Daily gage height, in feet, of Platte River at Columbus, Nebr., for 1910.

Day.	Sept.	Oct	Nov.	Day.	Sept.	Oct.	Nov.	Day.	Sept.	Oct.	Nov.
1	1.55	0.55		11				21			
2	1.0	55		12				22			
3	1 0	1 1		13				23	0.2		
4	.95	1 15		14				24	4		
5	7	1 1		15				25	.9		0.48
6	6			16				26	.85		
7				17				27	.7		
8		8		18				28	.65		
9				19				29			
10				20				30			
								31			

NOTE.—The observer records that there was no flow Sept. 7 to 22, 29, 30, Oct. 9 to Nov. 24. The hydrographer stated that the river at this point was practically dry all the season.

LARAMIE RIVER BASIN.

DESCRIPTION.[1]

Laramie River has its source in the mountains of northern Colorado, its headwaters adjoining those of the Cache la Poudre on the west. Irrigation is practiced in the basin of this river on a small scale in Colorado, but principally for hay ranches, the elevation being too great for diversified farming. After crossing the Wyoming line Laramie River soon leaves its canyon and enters the Laramie Plains, which are extensively irrigated from the main stream and its various tributaries, notably Little Laramie River, the low-water flow of which is now entirely used. Farther down the river passes through another canyon, and finally enters the plain of lower Laramie River, which extends from the eastern edge of Laramie Hills to the mouth of the river. It enters the North Platte at Fort Laramie, Wyo.

The highest point of diversion on Laramie River is the canal of the Water Supply & Storage Co. of Colorado, called the Sky Line canal, which takes water into Cache la Poudre River. This canal is at an elevation of about 10,000 feet above sea level, is 5 miles long, and was built principally through solid rock at a cost of about $90,000. Its maximum capacity is 100 second-feet. On account of its altitude this canal is not practically available until late in June. The taking

[1] For a more detailed description of this basin see the annual reports of the U. S. Geol. Survey, listed in Water-Supply Paper 119, 1905, p. 121.

of this water from Laramie River is a source of loss to irrigators in Wyoming, as none of the water returns to the stream through seepage or percolation.

LARAMIE RIVER AT GLENDEVEY, COLO.

This station is located at highway bridge one-eighth mile west of Glendevey post office, on the State road between Fort Collins and Waldon, Colo., in the NW. ¼ sec. 36, T. 10 N., R. 76 W., just below the mouth of Nunn Creek, which enters from the east, and some distance below the confluence of Spring Creek with the Laramie and some distance above McIntyre Creek, both of which streams enter from the west. It was established June 24, 1904, discontinued October 31, 1905, and reestablished August 18, 1910.

The drainage area at this station is 221 square miles. Some water is diverted above the station for irrigation.

A 2 by 4 vertical staff gage, graduated to feet and tenths, fastened to northwest corner of wooden pier near east end of wagon bridge, was used from June 24, 1904, to October 31, 1905. A new staff gage fastened to the northwest corner of first pier from right bank on August 18, 1910, was established at same datum as gage used in 1904 and 1905.

November 17, 1910, a Bristol automatic gage was established at this station, with datum same as that of vertical staff gage. (See Pl. IV, *B*, p. 270.)

The channel is straight for about 200 feet above the station.

At low stages measurements are made by wading; during high water measurements are made with cable from the lower side of bridge. The section is rather rough, consisting of gravel and bowlders. Gage heights are very much affected by ice during the winter.

Results should be fair.

This station is maintained by the State engineer of Colorado, who has furnished the data for publication. They have not been verified by engineers of the United States Geological Survey.

Discharge measurements of Laramie River at Glendevey, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 19	C. C. Hezmalhalch	38	42.7	1.90	30
Sept. 28	do	38	40.2	1.90	26
Nov. 7	W. B. Freeman	33	30	1.86	28
8[a]	do	31	24.4	1.69	14

[a] Some slush ice.

NOTE.—All measurements made by wading.

Daily gage height, in feet, and discharge, in second-feet, of Laramie River at Glendevey, Colo., for 1910.

[A. L. Fairhurst, observer.]

Day.	Aug.		Sept.		Oct.		Nov.		Dec.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			1.9	31	1.90	31	1.9	31	1.7	15
2			1.95	36	1.9	31	1.9	31	1.75	18
3			2.1	56	1.8	22	1.9	31	1.85	26
4			2.2	76	2.0	42	1.9	31	1.85	26
5			2.2	76	2.0	42	1.9	31	1.8	22
6			2.0	42	2.0	42	1.9	31	1.8	22
7			1.9	31	2.0	42	1.8	22	1.8	22
8			1.9	31	1.95	36	1.85	26	1.75	18
9			1.9	31	1.9	31	1.75	18	1.80	22
10			2.1	56	1.9	31	1.8	22	1.75	18
11			1.95	36	1.9	31	1.8	22	1.8	22
12			1.90	31	1.9	31	1.8	22	1.7	15
13			1.95	36	1.9	31	1.8	22	1.75	18
14			2.1	56	1.9	31	1.75	18	1.9	31
15			1.95	36	1.9	31	1.8	22	1.75	18
16			1.9	31	1.9	31	1.8	22	1.75	18
17			2.0	42	1.95	36	1.85	26	1.75	18
18	1.9	31	2.05	49	2.05	49	1.7	15	1.70	15
19	1.9	31	2.1	56	2.05	49	1.75	18	1.65	13
20	1.9	31	2.05	49	2.0	42	1.7	15	1.65	13
21	1.95	36	2.0	42	2.05	49	1.7	15	1.65	13
22	1.9	31	2.0	42	2.1	56	1.75	18	1.7	15
23	1.9	31	2.0	42	2.0	42	2.0	42	1.75	18
24	1.9	31	2.0	42	2.0	42	2.0	42	1.85	26
25	1.85	26	2.0	42	1.95	36	2.0	42	1.8	22
26	1.9	31	2.0	42	1.9	31	1.95	36	1.75	18
27	1.9	31	1.9	31	1.9	31	1.85	26	1.85	26
28	1.9	31	1.9	31	1.9	31	2.0	42	1.8	22
29	1.9	31	1.9	31	1.95	36	2.0	42	1.7	15
30	1.9	31	1.9	31	1.9	31	2.0	42	1.8	22
31	1.9	31			1.9	31			1.95	36

NOTE.—These data are published as furnished by the State engineer of Colorado. They have not been verified by the engineers of the United States Geological Survey.

Monthly discharge of Laramie River at Glendevey, Colo., for 1910.

[Drainage area, 102 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
Aug. 18–31	36	26	31.0	0.304	0.15	861
September	76	31	42.1	.413	.46	2,510
October	56	31	36.4	.357	.41	2,240
November	42	15	27.4	.269	.30	1,630
December	31	13	20.1	.197	.23	1,240

NOTE. These estimates were computed by the United States Geological Survey from data furnished by the State engineer of Colorado.

SOUTH PLATTE RIVER BASIN.

DESCRIPTION.

The South Platte rises in the mountainous region surrounding the large basin near the center of the State of Colorado, known as South Park, and in the long eastern slopes of the high mountains forming the Continental Divide. The river might properly be said

to be formed at South Platte, Colo., by the junction of the North and South forks. The drainage area of the South fork comprises about 2,150 square miles and that of the North Fork only about 450 square miles, but there is little difference in the mean annual flow of the two branches. The North Fork is about 50 miles long and the South Fork a little over 100 miles. Geneva Creek, with a drainage area of 50 square miles, is the most important tributary of the North Fork, other tributaries being Deer Park, Elk, and Buffalo creeks. Tarryall Creek and Goose Creek are the principal tributaries of the South Fork.

South Fork, usually considered the main branch of the river, flows in an easterly direction to Lake George, then northward to its junction with the North Fork, and on to the mouth of the Cache la Poudre near Greeley. From Greeley its general course is eastward until it joins the North Platte at the town of North Platte, Nebr.

At the mouth of the South Platte its elevation is 2,800 feet above sea level; 100 miles above the mouth it is 3,600 feet; at Denver, 288 miles above the mouth, it is 5,170 feet; and at South Platte, 30 miles above Denver, it is about 6,100 feet. Lake George, about 50 miles up the South Fork, is 8,000 feet above sea level, and Cheesman reservoir, 23 miles up from South Platte, is 6,850 feet. At the mouth of Geneva Creek, at Grant, Colo., 40 miles up the North Fork from South Platte, the elevation is about 8,500 feet.

The drainage basin, which comprises about 20,000 square miles above Julesburg, Colo., is bisected in an irregular way by the channel of the South Platte. To the north and west lies the mountainous portion, which consists of a long, narrow strip, extending in a north-south direction from a point a short distance above the south boundary of Wyoming to Palmer Lake, Colo. This area furnishes at least 90 per cent of the total run-off of the basin. South and east of the river the basin lies entirely within the plains region.

The mountainous region consists of peaks and jagged masses of granite, with sedimentary rocks cut and gashed by stream channels along the foothills. The stream gradients are steep, and many of the streams consist of series of cascades and rapids. The soil cover as a whole is light, and except during spring freshets or heavy storms the streams are remarkably free from sediment in suspension.

The lower basin, somewhat scarred and broken along the foothills, gradually merges farther east into the undulating prairies so characteristic of the Great Plains east of the Rocky Mountains. The soils of the plains are the product of the disintegration of shales and sandstones, and range from adobe clays to sandy loams. The controlling vegetation is largely native grasses, the only timber being a few bunches of scraggly cottonwoods along the stream channels and small patches of pine, cedar, and piñon along the higher portions.

Tho forest cover of the mountains, consisting originally of coniferous trees, is rapidly disappearing, but, through the occurrence of fires, a foothold has been furnished for the deciduous aspen, which is gradually increasing its dominion. Most of the timberland in this drainage is included in the Pike and Medicine Bow national forests; in all there are probably 1,000 square miles of merchantable timberlands.

The tributaries of the South Platte comprise, first, the small streams that rise on the eastern slope of the Rocky Mountains and, second, the plains streams. The mountain streams furnish a perennial supply of water, the amount of which, however, varies with the snowfall, being light during the latter part of the summer and in the fall and winter, and large during the spring floods. This water is almost entirely diverted for irrigation and does not reach the South Platte except in times of heavy floods. The principal streams of this class are Bear, Clear, St. Vrain, Boulder, and Big Thompson creeks, and Cache la Poudre River. The plains streams are all intermittent and furnish water only during storms or in the season of melting snow. The chief streams of this class are Cherry, Lone Tree, Crow, Kiowa, Boxelder, Bijou, Beaver, and Pawnee creeks.

In the mountainous regions the flow of the South Platte is perennial, but in the plains area the volume is greatly diminished by the numerous irrigation diversions. At North Platte, Nebr., just above the mouth of the river, the stream channel is dry for the greater part of the year, or consists of several small channels carrying a few second-feet of water.

The river is subject to periodic floods that occur in May and June, the magnitude varying from year to year with seasonal precipitation and temperature. At Julesburg, Colo., the stream flow varies from nothing up to 12,000 second-feet.

The rainfall is 25 inches or more in the highest mountains; 15 to 20 inches between altitudes of 5,500 and 9,000 feet; 10 to 15 inches between 4,000 and 5,000 feet; and in the lower basin, below an elevation of 4,000 feet, from 15 to 20 inches annually.

The winters are very severe, especially above the points where the mountain streams emerge into the more open country. In the mountain sections the snowfall is heavy, and snowstorms are common on the plains areas, but here the snow usually disappears within a few days after each storm. During the winter months the river and its tributaries are frequently frozen over throughout their courses. The length of the ice period ranges from about two months in the vicinity of Julesburg, Colo., to about five months in the high mountains, where the streams are frozen almost to the bottom.

The South Platte basin contains the oldest cultivated and irrigated areas in Colorado. At present nearly 1,000,000 acres are under irri-

gation in Colorado from the South Platte and its tributaries. In fact, the entire normal flow is being used for this purpose, and additional irrigation will necessitate the construction of storage reservoirs or the diversion of water from other drainage areas. The North Grand ditch, which has been in operation for several years, diverts water from the North Fork of Grand River across the divide into the Cache la Poudre River. The Laramie-Poudre project, which is under construction will divert water from the headwaters of Laramie River, in the basin of the North Platte, into the Cache la Poudre, in the basin of the South Platte; and the Denver Reservoir & Irrigation Co. proposes to divert the headwaters of Fraser River, a tributary of the Grand, into the headwaters of South Boulder, a tributary of the South Platte. Other similar projects are under consideration. The storage of the flood waters of the intermittent streams in the lower basin offer opportunities for considerable irrigation development. Very little is known as to the flow of these streams, but it is certainly very large at times, and many excellent storage sites are available.

About half a million acre-feet of the annual flow from the mountain section of this basin is now being stored for irrigation in many small reservoirs, and a large part of the mountain flow is still available for irrigation by proper conservation and storage.

Conditions on the upper South Platte and its tributaries are unusually favorable for storage. Some of the many good sites are natural depressions or are situated on small tributaries, so that the reservoirs will have to be supplied by feeder canals. Of this type is the Standley reservoir of the Denver Reservoir & Irrigation Co. This reservoir, which has been practically completed at a height considerably less than shown on the original plans and has a capacity of about 50,000 acre-feet. It will undoubtedly be enlarged in the future.

The largest reservoir which has been constructed in the South Platte basin is the Cheesman Lake of the Denver Union Water Co. This reservoir, which was completed in 1904, has a maximum capacity of 79,000 acre-feet. Among other proposed reservoirs may be mentioned the Antero, Tarryall, Lake George, Lost Park, Eagle Rock, and Geneva. Opportunities for storage are also found on Clear Creek, Boulder, St. Vrain, Big Thompson, and the Cache la Poudre. Some excellent reservoir sites have been surveyed on the last-named stream. The reservoirs on the upper portions of these streams will be used primarily for power development, but the stored waters can also be used for irrigation in the valleys below.

Water-power development is necessarily limited to the mountainous parts of the drainage area. Many favorable opportunities for such development are presented on Geneva Creek, the South Fork, Clear Creek, Boulder Creek, Big Thompson Creek, and Cache la Poudre

River. Many power sites have been filed upon. The ultimate power development in this drainage basin will probably amount to nearly 200,000 horsepower, but present development is limited to numerous small plants with a total capacity of less than 5,000 horsepower. Most of these plants are on Clear Creek and Boulder Creek. The plant of the Eastern Colorado Power Co., on Boulder Creek, a few miles above Boulder, Colo., is now under construction, and when completed will have a capacity of probably 20,000 horsepower.

The following special reports contain information regarding the hydrography of Colorado and Nebraska:

Water resources of Colorado, by A. L. Fellows: Water-Supply Paper U. S. Geol. Survey No. 74, 1902.

Surface waters of Nebraska, by J. C. Stevens: Water-Supply Paper U. S. Geol. Survey No. 230, 1909.

SOUTH FORK OF SOUTH PLATTE AT FAIRPLAY, COLO.

This station, which is located at the steel highway bridge in Fairplay, Colo., was established October 17, 1910.

A temporary staff gage was installed at upstream side of bridge. Measurements are made from bridge during high stages and by wading at various sections during low stages.

The bed of the stream is rocky and fairly permanent. The stream is frozen over from three to four months.

This station is maintained in cooperation with the United States Forest Service.

The following discharge measurement was made by S. T. Harding:

October 17, 1910: Width, 17 feet; area, 14 square feet; gage height, 1 foot; discharge, 25 second-feet.

Daily gage height, in feet, of South Fork of South Platte River at Fairplay, Colo., for 1910.

[E. W. Brown, observer.]

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	.....	0.9	0.7	11	.....	0.9	.....	21	0.8	0.9	.....
2	.....	.9	.7	12	.....	.8	.....	22	1.1	.9	.....
3	.....	.9	.9	13	.....	1.1	.....	23	1.0	.8	.....
4	.....	.9	.....	14	.....	.9	.....	24	1.0	.9	.....
5	.....	.9	.8	15	.....	.9	0.7	25	1.0	.....	.....
6	.....	.8	.9	16	.....	.9	.7	26	1.0	.....	.....
7	.....	.9	.9	17	1.0	.7	.7	27	1.0	.9	.....
8	.....	.9	.9	18	1.0	.7	.8	28	1.0	.7	.....
9	.....	1.1	.9	19	1.0	.9	.8	29	.....	.7	.....
10	.....	1.0	.....	20	.9	.9	1.0	30	1.0	.....	.....
								31	1.0	.....	0.6

NOTE.—Observer away on days when gage was not read. Ice during greater part of December.

SOUTH FORK OF SOUTH PLATTE RIVER NEAR LAKE GEORGE, COLO.

This station was established October 22, 1910, by the United States Geological Survey, in cooperation with the United States Forest Service. It is located one-fourth mile below Lake George, Colo., on highway bridge, near Hayman (Lake George) post office.

A vertical staff gage is attached to the bridge on left downstream side of center pier.

Measurements are made from bridge or by wading. Section is rather poor.

The channel is of gravel and cobbles and liable to shift.

Gage heights are affected by ice during winter months, and measurements are somewhat affected by a 2-foot dam 50 feet below the gage.

Discharge measurements of South Fork of South Platte River near Lake George, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Oct. 22	S. T. Harding	22.5	24.5	1.78	58
Nov. 18[a]	G. H. Russell	29	48	1.43	22

[a] Thin ice along edges. Made by wading 200 feet below gage.

Daily gage height, in feet, of South Fork of South Platte River near Lake George, Colo., for 1910.

[By F. C. Parrett, observer.]

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1			1.3	11		1.7		21		1.65	1.0
2				12		1.7	1.3	22	1.8	1.65	.9
3		1.55		13		1.7	1.3	23	1.8	1.7	.9
4		1.6	1.35	14		1.6	1.2	24	1.8	1.65	.85
5		1.65	1.3	15		1.65	1.35	25	1.8		.8
6			1.2	16		1.65		26	1.8		.8
7		1.6	1.2	17			1.2	27	1.75	1.6	.7
8		1.65	1.3	18		1.45		28	1.8	1.55	
9		1.7	1.2	19			1.2	29	1.7	1.5	.75
10		1.65		20			1.1	30	1.7	1.45	.7
								31	1.7	1.3	.7

NOTE.—No ice notes reported.

SOUTH FORK OF SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

This station, which was established May 8, 1905, to determine the amount of water available on this branch of the South Platte for power and irrigation, is located at South Platte, Colo., in T. 7 S., R. 70 W.

The North and South forks of the South Platte unite about 600 feet below the station, and the Cheesman reservoir, which intercepts the flow of Tarryall and Goose creeks in addition to that of the main branch, is about 20 miles above. No very important tributaries

enter below Cheesman Lake. The drainage area above the station is 2,160 square miles, of which probably less than 20 per cent can be classed as timbered land.

No water is diverted above this point except for the irrigation of hay lands in South Park, but the flow is regulated by the Cheesman reservoir, which has a capacity of 79,000 acre-feet. So many filings for power development have been made on this stream that it is doubtful whether additional filings can be made except near the headwaters.

The flow of the river at this station is affected by ice for about three months in the winter season.

No change has been made in the inclined rod gage since it was first established, and the datum remains the same. Discharge measurements are made from a cable near the gage and by wading.

Fair results should be obtained at this station, but as the bed is shifting, frequent measurements are necessary. The gage heights are apt to show fluctuation at certain times of the year owing to storage or release of water in the Cheesman reservoir.

Discharge measurements of South Fork of South Platte River at South Platte, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 24[a]	G. H. Russell	45	44	2.30	135
Feb. 15	do	26	30	1.90	74
Mar. 7	Thos. Grieve	61	84	2.78	303
Apr. 2	G. H. Russell	65	90	2.65	272
27	do	64	92	2.85	315
May 9	W. B. Freeman	69	106	2.80	335
June 4	R. C. Miles	64	88	2.70	320
20	G. H. Russell	61	83	2.75	285
July 19	do	43	39	1.90	82
24	Grieve and Christiansen	42	42	2.05	95
28	Lyon and Johnson		85	2.80	341
Aug. 9	Hezmalhalch and Ferguson	63.5	83	2.83	306
11	G. H. Russell	65	135	3.33	582
25	Russell and Padgett	63	54	2.00	124
Sept. 24	Padgett and Miles	37	61	2.10	136
Oct. 31	G. H. Russell	39	60	2.05	114
Nov. 22	H. D. Padgett	36	36	1.8	62
Dec. 15[b]	R. C. Miles	23	33	1.55	42

[a] Open channel conditions. [b] Channel full of floating ice.

NOTE.—All measurements excepting those of Apr. 27, June 4, and Aug. 10, made by wading.

Daily gage height, in feet, of South Fork of South Platte River at South Platte, Colo., for 1910.

[E. H. Jardin, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.25	2.2	2.0	2.6	3.1	2.7	2.45	2.25	2.05	2.0	1.9	1.7
2	2.3	2.15	2.1	2.6	3.1	2.7	2.7	3.15	2.05	2.0	1.85	1.7
3	2.2	2.1	2.2	2.65	3.1	2.7	2.9	3.4	2.0	2.0	1.8	1.7
4	2.2	2.0	2.2	2.6	3.2	2.7	2.8	3.3	2.0	1.95	1.85	1.7
5	2.2	2.0	2.5	2.6	3.25	2.7	2.8	3.1	2.0	1.9	1.95	1.6
6	2.4	2.0	2.7	2.6	3.05	2.7	2.8	3.05	1.9	1.9	2.0	1.65
7	2.5	1.9	2.7	2.0	3.0	2.95	2.8	3.0	1.85	1.9	2.0	1.7
8	2.5	1.7	2.7	2.0	2.9	2.85	2.8	2.9	1.85	1.9	2.0	1.7
9	2.6	1.7	2.75	2.0	2.8	2.8	2.35	2.85	1.95	1.95	2.05	1.75
10	2.6	1.7	3.6	2.6	2.8	2.75	1.9	3.3	1.85	1.95	2.1	1.7

Daily gage height, in feet, of South Fork of South Platte River at South Platte, Colo., for 1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	2.3	1.75	3.55	2.65	2.8	2.8	1.9	3.5	1.9	1.95	2.1	1.7
12	2.3	1.65	3.4	2.65	2.9	2.7	1.9	3.5	1.9	1.95	2.05	1.7
13	2.3	1.7	3.3	2.7	2.9	2.75	1.9	3.5	1.9	1.9	2.0	1.65
14	2.25	1.75	3.2	2.85	2.8	2.65	1.9	3.5	1.9	1.95	2.05	1.65
15	2.3	1.9	3.2	2.8	3.0	2.75	1.9	3.1	1.9	1.95	2.05	1.65
16	2.3	1.9	3.1	2.6	2.95	2.8	1.9	2.0	1.9	1.95	2.05	1.65
17	2.4	1.95	3.15	2.65	3.05	2.8	2.0	2.55	2.0	2.0	2.0	1.65
18	2.4	1.95	3.2	2.65	3.25	2.9	2.05	2.55	1.95	2.0	2.0	1.8
19	2.5	2.0	3.2	2.65	3.15	2.9	2.0	2.55	1.9	2.0	1.95	1.8
20	2.45	2.1	3.2	2.7	2.95	2.7	2.1	2.8	1.9	2.0	1.9	1.7
21	2.5	2.25	3.2	2.8	2.95	2.5	2.1	2.9	2.05	2.0	1.9	1.8
22	2.5	2.2	3.2	2.85	3.0	2.6	2.15	2.9	2.1	2.15	1.8	1.9
23	2.45	2.2	2.9	2.85	3.1	2.6	2.1	2.9	2.25	2.15	1.85	1.85
24	2.3	2.1	2.9	2.85	3.2	2.6	2.1	2.9	2.15	2.15	1.8	1.85
25	2.25	2.0	2.9	2.9	3.2	2.2	2.75	2.0	2.15	2.15	1.75	1.9
26	2.15	2.0	2.8	2.9	3.1	2.2	2.75	2.05	2.15	2.15	1.85	1.9
27	2.2	2.0	2.8	2.9	2.9	2.1	2.75	2.1	2.15	2.1	1.85	1.9
28	2.2	2.0	2.7	2.9	3.0	2.15	2.8	2.05	2.15	2.1	1.7	2.1
29	2.15	.....	2.7	3.0	2.85	2.2	3.6	2.05	2.15	2.1	1.8	2.0
30	2.2	.....	2.6	3.0	2.7	2.2	2.8	2.0	2.15	2.1	1.8	2.0
31	2.2	.....	2.6	.....	2.7	.....	2.75	2.1	.....	2.1	.....	2.05

NOTE.—Ice Jan. 1 to 10, and Dec. 18 to 31.

Daily discharge, in second-feet, of South Fork of South Platte River at South Platte, Colo., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	120	98	250	414	280	205	152	108	98	80	48
2	.....	110	118	250	414	280	280	431	108	98	71	48
3	.....	100	140	265	414	280	343	528	98	98	62	48
4	.....	80	140	250	450	280	310	488	98	89	71	48
5	.....	80	220	250	469	280	310	414	98	80	89	38
6	.....	80	280	250	396	280	310	396	80	80	98	43
7	.....	70	280	98	378	360	310	378	71	80	98	48
8	.....	40	280	98	343	326	310	343	71	80	98	48
9	.....	40	295	98	310	310	178	326	89	89	108	55
10	.....	40	608	250	310	295	80	488	71	89	118	48
11	135	50	588	265	310	310	80	568	80	89	118	48
12	135	40	528	265	343	280	80	568	80	89	108	48
13	135	45	488	280	343	295	80	568	80	80	98	43
14	122	55	450	326	310	265	80	568	80	89	108	43
15	135	80	450	310	378	295	80	414	80	89	108	43
16	135	80	414	250	360	310	80	98	80	89	108	43
17	160	89	432	265	396	310	98	235	98	98	98	43
18	160	89	450	265	469	343	108	235	89	98	98	.....
19	185	98	450	265	432	343	98	235	80	98	89	.....
20	172	118	450	280	360	280	118	310	80	98	80	.....
21	185	152	450	310	360	220	118	343	108	98	80	.....
22	185	140	450	326	378	250	129	343	118	129	62	.....
23	172	140	343	326	414	250	118	343	152	129	71	.....
24	135	118	343	326	450	250	118	343	129	129	62	.....
25	122	98	343	343	450	140	295	98	129	129	55	.....
26	100	98	310	343	414	140	295	108	129	129	71	.....
27	110	98	310	343	343	118	295	118	129	118	71	.....
28	110	98	280	343	378	129	310	108	129	118	48	.....
29	100	.....	280	378	326	140	608	108	129	118	62	.....
30	110	.....	250	378	280	140	310	98	129	118	62	.....
31	110	.....	250	.....	280	.....	295	118	.....	118	.....	.....

NOTE.—These discharges are based on rating tables applicable as follows: Jan. 11 to 31, not well defined; Feb. 1 to 14, indirect method for shifting channels used; Feb. 15 to Dec. 17, fairly well defined between 62 and 380 second-feet.

Monthly discharge of South Fork of South Platte River at South Platte, Colo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January			[a] 129	7,930	D.
February	152	40	87.4	4,850	C.
March	608	98	347	21,300	B.
April	378	98	275	16,400	B.
May	469	280	377	23,200	B.
June	360	118	259	15,400	B.
July	608	80	207	12,700	B.
August	568	98	318	19,600	C.
September	152	71	100	5,950	C.
October	129	80	101	6,210	C.
November	118	48	85.0	5,060	C.
December			[1] 45.6	2,800	C.
The period			195	141,000	

[a] Discharge estimated because of ice Jan. 1 to 10 and Dec. 18 to 31.

SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

This station, which was established March 28, 1902, furnishes valuable data for use in connection with storage, irrigation, and water-power development. It is located on the Colorado & Southern Railway in T. 7 S., R. 7 W., about 9 miles above the mouth of the canyon and just below the junction of the North and South forks. Records at Platte Canyon and at Deansbury, a few miles below, extend back to 1887, with the exception of the years 1893 and 1894, and records at Platte Canyon are still being taken by the Denver Union Water Co. The earlier records, 1887–1892, were taken by the State engineer, and the records from 1895 to 1898 were taken under the direction of the Denver Power & Irrigation Co.

The station is especially important because of its location above the head gates of all irrigation systems and also above the intake of the Denver Union Water Co. The location of the Cheesman storage reservoir on the South Fork, 20 miles above this station, and the proposed installation of several power plants on both forks of the river above add to the importance of the station.

A great many filings for power development have been made on the tributaries of the river above this point, but doubtless opportunities for additional filings still exist.

The flow of the South Fork of the South Platte is regulated by storage in Cheesman reservoir. The flow of the North Fork is natural, except for slight variations due to the many ice and fishponds for 30 miles above its mouth.

The river and its tributaries are usually frozen over from two to four months during the winter time.

On May 7, 1905, the gage was moved from the county bridge to a point 150 feet downstream, which no doubt caused some change in the relation of gage readings. This gage, was an inclined rod. Since

March 14, 1910, a Bristol automatic gage established by the state engineer has been used. It is at the same location as the rod gage and is referred to the same datum. Discharge measurements are made from a cable near the gage and by wading.

The stream bed is more or less shifting, and frequent discharge measurements are necessary to obtain the best results. The gage readings are apt to show considerable fluctuation owing to the regulation of the flow from the Cheesman reservoir. The records from 1895 to 1898 were bought by the Denver Union Water Co. from J. E. Rhodes, representing the Denver Power & Irrigation Co.

Discharge measurements of South Platte River at South Platte, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 24[a]	G. H. Russell	42	64	2.18	203
Feb. 15[a]	do	42	59	1.90	152
Mar. 7	Thos. Grieve	76	116	2.62	356
Apr. 2[a]	G. H. Russell	57	118	2.68	392
27	do	77	154	3.16	555
May 9	W. B. Freeman	78.5	154	3.18	536
June 5	R. C. Miles	75	146	3.28	556
20	G. H. Russell	77	135	2.90	423
July 19[a]	do	40	64	1.95	154
24[a]	Grieve and Christiansen	74	80	2.05	192
28	Lyon and Johnson	.....	119	2.60	411
Aug. 9	Hezmalhalch and Ferguson	80	125	2.82	388
11	G. H. Russell	76	160	3.40	648
25	Russell and Padgett	75	82	2.10	196
Sept. 24[a]	Miles and Padgett	65	71	2.05	199
Oct. 31	G. H. Russell	48.5	73	2.00	161
Nov. 22[a]	H. D. Padgett	55	57	1.80	112
Dec. 15[b]	Miles and Arnold	36	41	1.68	62

[a] Wading measurement; very little ice. [b] Made by wading. River full of floating ice.

Daily gage height, in feet, of South Platte River at South Platte, Colo., for 1910.

[E. H. Jardin and A. Vermillion, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	2.0	1.9	2.6	3.3	3.25	2.8	2.6	1.9	1.8	1.85	1.5
2	2.4	2.1	2.0	2.65	3.3	3.25	2.8	3.2	1.95	1.8	1.8	1.5
3	2.5	2.0	2.2	2.65	3.3	3.25	2.9	3.35	1.9	1.8	1.8	1.6
4	2.3	1.9	2.2	2.5	3.4	3.25	2.85	3.2	1.95	1.8	1.8	1.6
5	2.3	1.9	2.5	2.5	3.4	3.1	2.85	3.05	1.9	1.75	1.9	1.4
6	2.5	1.9	2.6	2.45	3.25	3.1	2.8	3.1	1.8	1.75	1.85	1.35
7	2.6	1.7	2.55	2.5	3.2	3.2	2.75	3.0	1.75	1.75	1.85	1.4
8	2.7	1.7	2.65	2.5	3.15	3.15	2.65	2.8	1.75	1.8	1.95	1.55
9	2.7	1.7	2.7	2.5	3.15	3.1	2.55	2.65	1.85	1.75	1.95	1.65
10	2.5	1.65	3.55	2.5	3.15	3.05	2.1	3.25	1.85	1.75	1.95	1.55
11	2.5	1.7	3.55	2.55	3.15	3.05	2.05	3.2	1.75	1.8	1.95	1.5
12	2.6	1.7	3.4	2.6	3.2	3.1	2.0	3.3	1.75	1.75	1.95	1.45
13	2.6	1.75	3.3	2.7	3.3	3.0	2.0	3.25	1.8	1.65	1.9	1.4
14	2.45	1.8	3.3	2.85	3.4	3.1	2.0	3.1	1.8	1.7	1.85	1.25
15	2.5	1.9	3.3	2.8	3.4	3.0	2.05	2.2	1.8	1.8	1.9	1.45
16	2.3	2.0	3.3	2.65	3.35	3.1	2.05	2.1	1.8	1.9	1.9	1.75
17	2.4	1.9	3.25	2.7	3.3	3.15	2.05	2.25	1.8	1.95	1.8	1.8
18	2.5	1.95	3.3	2.7	3.5	3.1	2.05	2.35	1.8	1.85	1.85	1.9
19	2.5	2.0	3.25	2.75	3.4	3.05	1.9	2.35	1.8	1.85	1.85	2.0
20	2.6	2.1	3.3	2.8	3.2	2.9	1.95	2.35	1.8	1.9	1.75	1.9
21	2.6	2.2	3.25	2.95	3.15	2.7	2.1	2.55	1.85	1.9	1.75	2.0
22	2.55	2.25	3.2	2.9	3.25	2.75	2.2	2.6	1.95	1.95	1.8	2.0
23	2.6	2.2	3.25	2.95	3.45	2.7	2.25	2.6	1.95	1.95	1.75	1.9
24	2.2	2.2	3.2	3.0	3.5	2.65	2.2	2.6	1.95	1.9	1.85	2.05
25	2.2	2.0	3.05	3.05	3.45	2.65	2.6	2.15	1.9	1.9	1.85	2.1

Daily gage height, in feet, of South Platte River at South Platte, Colo., for 1910—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	2.2	2.1	3.0	3.05	3.3	2.5	2.55	1.95	1.9	1.85	1.75	.....
27	2.0	2.1	2.85	3.1	3.3	2.45	2.55	1.95	1.9	1.8	1.7	.....
28	2.1	2.0	2.75	3.15	3.3	2.4	2.6	1.95	1.9	1.8	1.55	.....
29	2.2	.....	2.75	3.25	3.3	2.4	3.25	2.0	1.9	1.85	1.6	.....
30	2.1	.....	2.6	3.3	3.25	2.75	3.2	1.9	1.9	1.8	1.55	.....
31	2.15	.....	2.55	.....	3.25	.....	3.35	1.9	.....	1.95	.....	.....

NOTE.—Gage heights affected by ice Jan. 1 to 23 and Dec. 16 to 31.

Daily discharge, in second-feet, of South Platte River at South Platte, Colo., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	170	146	343	590	571	408	395	146	124	135	65
2	.....	196	170	359	590	571	408	610	158	124	124	65
3	.....	170	224	359	590	571	443	660	146	124	124	80
4	.....	146	224	312	630	571	426	605	158	124	124	80
5	.....	146	312	312	630	515	426	535	146	114	146	50
6	.....	146	343	297	571	515	408	545	124	114	135	45
7	.....	104	328	312	552	552	392	500	114	114	135	50
8	.....	104	359	312	534	534	359	420	114	124	158	60
9	.....	104	375	312	534	515	328	359	135	114	158	70
10	.....	95	690	312	534	496	196	571	135	114	158	60
11	.....	104	690	328	534	496	183	552	114	124	158	50
12	.....	104	630	343	552	515	170	590	114	114	158	50
13	.....	114	590	375	590	478	170	571	124	95	146	50
14	.....	124	590	416	630	515	170	515	124	104	135	35
15	.....	146	590	408	630	478	183	224	124	124	146	55
16	.....	170	590	359	610	515	183	196	124	146	146	.....
17	.....	146	571	375	590	534	183	238	124	158	124	.....
18	.....	158	590	375	670	515	183	267	124	135	135	.....
19	.....	170	571	392	630	496	146	267	124	135	135	.....
20	.....	196	590	408	552	443	158	267	124	146	114	.....
21	.....	224	571	460	534	375	196	328	135	146	114	.....
22	.....	238	552	443	571	392	224	343	158	158	124	.....
23	.....	224	571	460	650	375	238	343	158	158	110	.....
24	224	224	552	478	670	359	224	343	158	146	130	.....
25	224	170	496	496	650	359	360	210	146	146	125	.....
26	224	196	478	496	590	312	360	158	146	135	105	.....
27	170	196	426	515	590	297	380	158	146	124	95	.....
28	196	170	392	534	590	282	410	158	146	124	75	.....
29	224	.....	392	571	590	282	645	170	146	135	80	.....
30	196	.....	343	590	571	392	625	146	146	124	70	.....
31	210	.....	328	.....	571	.....	675	146	.....	158	.....	.....

NOTE.—These discharges are based on rating curves applicable as follows: Jan. 24 to July 24 and Aug. 9 to Nov. 22, fairly well defined between 124 and 670 second-feet; July 25 to Aug. 8, indirect method for shifting channels used.

Monthly discharge of South Platte River at South Platte, Colo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	199	12,200	D.
February	238	95	159	8,830	C.
March	690	146	460	28,300	B.
April	590	297	402	23,900	B.
May	670	534	591	36,300	B.
June	571	282	461	27,400	B.
July	675	146	318	19,600	B.
August	660	146	367	22,600	B.
September	158	114	136	8,090	C.
October	158	95	130	7,990	B.
November	158	70	127	7,560	C.
December	.....	.....	58.9	3,620	D.
The year	.....	.....	285	206,000	

NOTE.—Mean discharge estimated on account of ice for Jan. 1–23 at 195 second-feet and for Dec. 16–31 at 60 second-feet.

SOUTH PLATTE RIVER AT DENVER, COLO.

This station, which is located a short distance below the mouth of Cherry Creek, was maintained under the direction of the United States Geological Survey from 1895 to 1906, and since that time more or less intermittent records have been taken by the State engineer's office.[1] The station affords data concerning the amount of water available for irrigation.

The rod gage used from 1906 to August 11, 1909, inclusive, is located on the right bank about 100 feet above the Sixteenth Street viaduct. Beginning August 12, 1909, a Bristol automatic gage, at practically the same datum, fastened to a pier of the Sixteenth Street viaduct, has been used.

Discharge measurements are made from the Fifteenth Street Bridge and by wading.

The flow of the stream at this point is seldom affected by ice.

This station is maintained by the State engineer of Colorado, who has furnished the data for publication.

Discharge measurements of South Platte River at Denver, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 12[a]	Grieve and Chatfield	91	120	1.30	256
Feb. 14[b]	Thomas Grieve	102	85	1.22	165
Mar. 10[a]	....do	134	269	2.35	711
Apr. 8[b]	F. Cogswell		145	1.62	361
23[b]	....do		162	1.63	386
May 5[b]	....do		197	1.80	524
17[b]	....do		195	1.87	526
June 4[c]	Chatfield and Hezmalhalch		174	1.95	512
17[d]	F. Cogswell		124	1.49	331
July 7[e]	....do		74	.90	119
26[e]	Grieve and Christiansen	53	77	1.20	183
30[f]	....do	173	324	3.18	1,280
Aug. 22[g]	F. Cogswell		82	1.10	168
31[g]	....do		53	.80	86
Sept. 17[g]	....do		59	.95	101
Oct. 5[g]	....do		64	1.00	117
6[g]	Grieve and Hezmalhalch	45	53	.90	87
Nov. 11[b]	Christiansen and Hezmalhalch	46	57	.89	78

[a] From foot plank at Sixteenth Street viaduct.
[b] Wading measurement below Sixteenth Street.
[c] Made from bridge.
[d] Wading measurement at bridge.
[e] Wading measurement above gage.
[f] Made from Fifteenth Street Bridge.
[g] Wading measurement above Sixteenth Street viaduct.

Daily gage height, in feet, of South Platte River at Denver, Colo., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.25	1.45	1.35	1.7	1.8	1.65	1.45	1.75	0.9	1.05	0.8	0.9
2	1.85	1.4	1.3	1.65	2.15	1.85	1.4	1.25	.9	1.0	.8	.9
3	1.75	1.25	1.35	1.65	2.0	1.85	1.4	1.75	.95	1.0	.8	.9
4	1.5	1.2	1.45	1.7	1.8	1.95	1.4	2.0	1.0	1.0	.8	.9
5	1.2	1.25	1.45	1.65	1.8	1.85	1.35	1.9	1.05	.95	.8	.95
6	1.1	1.2	1.45	1.6	1.75	1.8	1.3	1.9	1.0	.95	.8	.85
7	1.25	1.2	1.55	1.55	1.55	1.85	1.1	1.9	.9	.95	.8	.85
8	1.35	1.15	1.95	1.5	1.45	1.8	.95	1.8	.85	.95	.8	.8
9	1.25	1.05	2.15	1.5	1.4	1.75	.8	1.75	.85	.95	.8	.85
10	1.25	1.0	2.25	1.45	1.4	1.55	.85	1.75	.85	.95	.85	.95

[1] This station is fully described in Water-Supply Paper U. S. Geol. Survey No. 208, p. 154.

Daily gage height, in feet, of South Platte River at Denver, Colo., for 1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	1.25	1.05	2.4	1.4	1.65	1.35	0.9	2.1	1.0	0.9	0.85	0.95
12	1.25	1.05	2.35	1.55	1.65	1.25	.8	2.15	.8	.9	.85	.95
13	1.2	1.05	2.15	1.8	1.75	1.3	.8	2.15	.85	.9	.85	1.0
14	1.25	1.2	2.05	1 95	2.05	1.4	.8	2.25	.95	.9	.85	.95
15	1.25	1.15	2.0	1.95	2.15	1.4	.8	2.0	.85	.95	.85	.8
16	1.3	1.05	2.0	1.8	2.25	1.35	.8	1.4	.9	1.0	.85	.85
17	1.35	.85	2.0	1.55	1.85	1.45	.75	1.4	.9	1.0	.9	.85
18	1.35	.85	2.05	1.4	1.65	1.45	.75	1.7	.9	1.0	.95	.85
19	1.4	1.05	2.1	1.5	1.7	1.45	.75	1.65	1.3	1.05	.9	.9
20	1.4	1.1	2.05	1.4	1.85	1.4	.8	1.55	1.0	1.1	.9	.95
21	1.35	1.1	2.1	1.5	1.9	1.25	.8	1.5	1.0	1.2	.85	.9
22	1.4	1.1	2.05	1.75	1.8	.95	.8	1.3	1.2	1.15	.95	.9
23	1.45	1.1	2.05	1.6	1.8	1.0	.8	1.3	1.45	1.15	1.05	.9
24	1.5	1.2	2.1	1.5	1.9	.9	.85	1.25	1.2	.95	1.05	.
25	1.6	1.25	2.05	1.6	1.9	1.0	1.1	1.15	1.2	1.0	1.15	.95
26	1.35	1.2	1.95	1.65	1.75	1.25	1.0	1.2	1.15	.95	1.15	.95
27	1.3	1.25	1.85	1.6	1.6	1.25	.85	1.4	1.1	.9	1.0	.95
28	1.4	1.35	1.8	1.55	1.5	1.25	1.1	1.55	1.15	.95	1.05	.9
29	1.45	.....	1.8	1.55	1.55	1.15	1.7	1.0	1.1	.9	.95	.9
30	1.35	.....	1.85	1.55	1.7	1.25	2.65	1.1	1.1	.9	.95	.9
31	1.35	.....	1.75	.....	1.7	.....	1.9	1.0	.....	.85	.....	.9

Daily discharge, in second-feet, of South Platte River at Denver, Colo., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	678	295	258	400	500	408	295	422	90	128	65	90
2	102	275	240	378	768	535	275	222	90	115	65	90
3	422	222	258	378	645	535	275	422	102	115	65	90
4	315	205	295	400	500	520	275	545	115	115	65	90
5	205	222	295	378	500	470	258	495	128	102	65	102
6	175	205	295	355	468	445	240	495	115	102	65	78
7	222	205	335	335	358	470	175	495	90	102	65	78
8	258	190	520	315	312	445	130	445	78	102	65	65
9	222	160	622	315	290	422	90	422	78	102	65	65
10	222	145	678	295	290	335	102	422	78	102	78	102
11	222	160	765	275	408	258	115	595	115	90	78	102
12	222	160	735	335	408	222	90	622	65	90	78	102
13	205	160	622	445	468	240	90	622	78	90	78	115
14	222	205	570	520	685	275	90	678	102	90	78	102
15	222	190	545	520	768	275	90	545	78	102	78	65
16	240	160	545	500	855	258	90	275	90	115	78	78
17	258	102	545	358	535	295	82	275	90	115	90	78
18	258	102	570	290	408	295	82	400	90	115	102	78
19	275	160	595	335	435	295	82	378	200	128	90	90
20	275	175	570	290	535	275	90	335	115	140	90	102
21	258	175	595	335	570	222	90	315	115	170	78	90
22	275	175	570	468	500	130	90	240	170	155	102	90
23	295	175	570	380	500	145	90	240	245	155	128	90
24	315	205	595	335	570	115	102	222	170	102	128	90
25	355	222	570	380	570	145	175	190	170	115	155	102
26	258	205	520	408	468	222	145	205	155	102	155	102
27	240	222	470	380	380	222	102	275	140	90	115	102
28	275	258	445	358	335	222	178	335	155	102	128	90
29	295	.....	445	358	358	190	400	145	140	90	102	90
30	258	.....	470	358	435	222	918	175	140	90	102	90
31	258	.....	422	.....	435	.....	495	145	.....	78	.....	90

NOTE.—These discharges were computed by the State engineer department of Colorado and are published herewith without change. They have not been verified by engineers of the United States Geological Survey. The discharges are based on rating curves applicable as follows: Jan. 1 to Apr. 15 and June 4 to Aug. 31; Apr. 16 to June 3; Sept. 1 to Dec. 31.

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Monthly discharge of South Platte River at Denver, Colo., for 1910.

[Drainage area, 3,840 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
January	678	102	268	0.070	0.08	16,500
February	295	102	191	.050	.05	10,600
March	765	240	501	.130	.15	30,800
April	520	275	373	.097	.11	22,200
May	855	290	492	.128	.15	30,300
June	535	115	304	.079	.09	18,100
July	918	82	187	.049	.06	11,500
August	678	145	374	.097	.11	23,000
September	245	65	120	.031	.03	7,140
October	170	78	110	.029	.03	6,760
November	155	65	89.9	.023	.03	5,350
December	115	65	89.9	.023	.03	5,530
The year	918	65	259	.067	.92	188,000

NOTE.—These estimates were computed by the United States Geological Survey from the daily discharge table furnished by the State engineer of Colorado published herewith.

SOUTH PLATTE RIVER NEAR KERSEY, COLO.

This station, which was established April 27, 1901, is located at a pile bridge about 1½ miles north of Kersey, on the Union Pacific Railroad about 6 miles east of Greeley, in T. 5 N., R. 64 W. The station was discontinued during the fall of 1903, but was reestablished March 5, 1905.

The station is below all the important tributaries of the South Platte that derive their supply from the mountain region, and the records are therefore particularly important as showing the amount of water available for storage reservoirs in northeastern Colorado.

Cache la Poudre River, a very important tributary of the South Platte, enters 2 or 3 miles above the station. Crow Creek and Boxelder Creek, two intermittent streams, come in from the north and south sides, 4 or 5 miles below. The drainage area at Kersey is 9,500 square miles.

Above Kersey are numerous irrigation and canal systems serving one of the most extensively irrigated areas in Colorado. Nearly 790,000 acres were irrigated above this station in 1907, about 380,000 acre-feet of water were stored, and about half of it used during the season. In 1908 about 300,000 acre-feet were stored, all of which was used for irrigation.

No important water-power plants are operated on the South Platte or its tributaries above the station, but one or two are now under construction and several are contemplated. In order to secure additional water rights for irrigation it will be necessary to construct storage works on some of the tributaries, as filings greatly in excess of the natural flow of the stream have been on record for a number of years.

The river is generally frozen over from the middle of December to the first of March.

In the fall of 1906 a chain gage was established on each of the two channels into which the river is divided at ordinary stages. Gage No. 1 is 30 feet from the right bank; gage No. 2 is 325 feet from the right bank. Formerly one rod gage was used, but it was found that the elevation of the water surface in the two channels differed considerably. Owing to the shifting character of the stream bed, a slight change in the datum of the gage is not apt to seriously affect the value of the results, as marked changes occur in the rating curve from one season to the next and often during a single season.

Measurements should be taken at this station on an average at least once every three weeks, except when the river is at a constant stage. Accurate results are rather difficult to obtain on account of the piles of the bridge and the fact that the bridge is not at right angles to the direction of the current. Whenever possible measurements should be taken by wading. At high stages the river flows in three channels and during extreme floods overflows into one or two channels on the left bank.

Discharge measurements of South Platte River near Kersey, Colo., in 1910.

[Gage No. 1.]

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 10	G. H. Russell	69	123	3.30	298
Mar. 21	do	83	179	3.75	442
Apr. 25	do	45	42	2.37	73
May 16	do	65	45	2.40	80
June 9	do	45	30	2.10	49
29	Turner and Miles	44	66	2.15	61
July 14	G. H. Russell	47	37	2.21	60
Aug. 9	do	39	38	2.26	57
Sept. 12	do	35	33	2.18	53
Oct. 8	Padgett and Miles	35	32	2.30	74
27	G. H. Russell	67	85	2.88	157
Nov. 26	Miles and Padgett	48	48	2.60	103
Dec. 29[a]	E. O. Christiansen	67	86	2.79	146

[a] Thin ice on edge and slush ice in channel.

NOTE.—All measurements excepting that of Dec. 29 made by wading at various sections.

Daily gage height, in feet, of South Platte River near Kersey, Colo., for 1910.

[Gage No. 1. Mrs. J. C. Maisner, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.8	3.65	3.45	3.4	2.35	2.2	2.15	2.2	2.2	2.2	2.85	2.75
2	3.85	3.65	3.5	3.25	2.5	2.15	2.15	2.2	2.2	2.2	2.85	2.7
3	4.3	3.65	3.45	3.25	2.75	2.1	2.15	2.2	2.2	2.25	2.8	2.6
4	4.05	3.5	3.45	3.15	2.9	2.1	2.15	2.25	2.2	2.3	2.75	2.6
5	3.7	3.4	3.45	3.3	2.85	2.1	2.15	2.25	2.2	2.3	2.75	2.55
6	3.55	3.45	3.5	2.95	2.7	2.1	2.15	2.3	2.15	2.3	2.75	2.6
7	3.6	3.4	3.45	3.0	2.5	2.1	2.15	2.3	2.15	2.3	2.8	2.75
8	3.5	3.4	3.5	2.85	2.4	2.1	2.2	2.3	2.15	2.3	2.85	2.8
9	3.55	3.45	3.45	2.8	2.3	2.1	2.2	2.25	2.15	2.3	2.9	2.8
10	3.65	3.4	3.7	2.65	2.2	2.05	2.25	2.2	2.2	2.3	2.8	2.8

Daily gage height, in feet, of South Platte River near Kersey, Colo., for 1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	3.6	3.35	3.75	2.7	2.1	2.05	2.3	2.25	2.2	2.3	2.75	2.8
12	3.55	3.4	3.9	2.65	2.1	2.05	2.3	2.25	2.2	2.5	2.8	2.8
13	3.6	3.35	3.8	2.8	2.2	2.1	2.25	.....	2.2	2.45	2.85	2.8
14	3.55	3.4	3.9	2.85	2.3	2.1	2.2	2.25	2.2	2.5	2.85	2.7
15	3.6	3.35	3.8	2.95	2.5	2.1	2.2	2.25	2.2	2.55	2.85	2.6
16	3.55	3.4	3.8	3.2	2.4	2.1	2.2	2.25	2.2	2.6	2.8	2.55
17	3.65	3.45	3.7	3.15	2.4	2.1	2.2	2.3	2.2	2.75	2.8	2.55
18	3.65	3.5	3.75	3.05	2.55	2.1	2.2	2.3	2.2	2.9	2.8	2.55
19	3.7	3.4	3.7	2.9	2.3	2.1	2.25	2.3	2.2	3.0	2.8	2.55
20	3.65	3.5	3.7	2.75	2.2	2.1	2.2	2.2	2.2	3.0	2.75	2.5
21	3.7	3.45	3.7	2.6	2.2	2.1	2.2	2.2	2.2	3.0	2.8	2.5
22	3.65	3.45	3.75	2.5	2.45	2.1	2.2	2.2	2.2	3.0	2.8	2.5
23	3.8	3.45	3.65	2.5	2.4	2.1	2.2	2.2	2.3	3.1	2.7	2.6
24	3.85	3.5	3.7	2.45	2.7	2.1	2.2	2.2	2.3	3.1	2.7	2.65
25	4.0	3.5	3.65	2.4	2.5	2.1	2.2	2.2	2.25	3.05	2.6	2.7
26	3.85	3.6	3.7	2.2	2.45	2.1	2.2	2.2	2.25	3.0	2.6	2.7
27	3.85	3.45	3.55	2.2	2.25	2.1	2.2	2.2	2.25	2.95	2.7	2.7
28	3.75	3.5	3.5	2.2	2.15	2.1	2.25	2.2	2.25	2.85	2.75	2.75
29	3.8	.....	.....	2.2	2.2	2.15	2.25	2.2	2.25	2.85	2.8	2.7
30	3.65	.....	3.3	2.3	2.2	2.15	2.25	2.2	2.2	2.85	2.75	2.7
31	3.7	.....	3.35	.....	2.15	.....	2.2	2.2	.....	2.8	.....	2.8

NOTE.—Ice Jan. 1 to 5.

Daily discharge, in second-feet, of South Platte River near Kersey, Colo., for 1910.

[Gage No. 1.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	410	338	320	72	59	56	59	59	59	157	133
2	.....	410	355	273	89	56	56	59	59	59	157	122
3	.....	410	338	273	133	53	56	59	59	63	144	104
4	.....	355	338	243	170	53	56	63	59	67	133	104
5	.....	320	338	288	157	53	56	63	59	67	133	96
6	373	338	355	184	122	53	56	67	56	67	133	104
7	390	320	338	198	89	53	56	67	56	67	144	133
8	355	320	355	157	77	53	59	67	56	67	157	144
9	373	338	338	144	67	53	59	63	56	67	170	144
10	410	320	430	113	59	50	63	59	59	67	144	144
11	390	304	450	122	53	50	67	63	59	67	133	144
12	373	320	510	113	53	50	67	63	59	89	144	144
13	390	304	470	144	59	53	63	[a] 63	59	83	157	144
14	373	320	510	157	67	53	59	63	59	89	157	122
15	390	304	470	184	89	53	59	63	59	96	157	104
16	373	320	470	258	77	53	59	63	59	104	144	96
17	410	338	430	243	77	53	59	67	59	133	144	96
18	410	355	450	213	96	53	59	67	59	170	144	96
19	430	320	430	170	67	53	63	67	59	198	144	96
20	410	355	430	133	59	53	59	59	59	198	133	89
21	430	338	430	104	59	53	59	59	59	198	144	89
22	410	338	450	89	83	53	59	59	59	198	144	89
23	470	338	410	89	77	53	59	59	67	228	122	104
24	490	355	430	83	122	53	59	59	67	228	122	113
25	550	355	410	77	89	53	59	59	63	213	104	122
26	490	390	430	59	83	53	59	59	63	198	104	122
27	490	338	373	59	63	53	59	59	63	184	122	122
28	450	355	355	59	56	53	63	59	63	157	133	133
29	470	.....	[a] 320	59	59	56	63	59	63	157	144	122
30	410	.....	288	67	59	56	63	59	59	157	133	122
31	430	.....	304	.....	56	.....	59	59	.....	144	.....	144

[a] Interpolated.

NOTE.—These discharges were obtained from a fairly well defined rating curve.

Discharge measurements of South Platte River near Kersey, Colo., in 1910.

[Gage No. 2.]

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq.ft.*	*Feet.*	*Sec.-ft.*
Feb. 10	G. H. Russell	70	193	3.40	522
Mar. 21	....do	150	203	3.60	550
Apr. 25	....do	47	52	2.20	131
May 16	....do	54.5	56	2.30	130
June 9	....do	31	22	1.56	38
June 29	Turner and Miles	46	32	.....	48
July 14	G. H. Russell	27	28	1.78	47
Aug. 9	....do	38	30	1.90	53
Sept. 12	....do	38.5	25	1.89	40
Oct. 8	Padgett and Miles	41	39	2.10	69
Oct. 27	G. H. Russell	56	130	2.87	269
Nov. 26	Miles and Padgett	45	65	2.70	183
Dec. 29[a]	E. O. Christiansen	75	169	2.84	258

[a] Slush ice in channel.

NOTE.—All above measurements excepting that of Dec. 29 made by wading at various sections.

Daily gage height, in feet, of South Platte River near Kersey, Colo., for 1910.

[Gage No. 2. Mrs. J. C. Maisner, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.7	3.7	3.5	3.35	2.1	1.85	1.7	1.7	1.85	1.9	3.3	2.85
2	3.9	3.65	3.5	3.3	2.2	1.85	1.7	1.7	1.85	1.9	3.3	2.9
3	4.2	3.6	3.5	3.2	2.6	1.6	1.7	1.7	1.85	2.25	3.3	2.7
4	4.0	3.5	3.5	3.1	3.25	1.6	1.7	1.7	1.85	2.15	3.3	2.6
5	3.8	3.5	3.5	3.25	2.8	1.55	1.7	1.75	1.85	2.15	3.3	2.6
6	3.65	3.5	3.5	2.9	2.4	1.6	1.7	1.9	1.8	2.15	2.85	2.6
7	3.7	3.45	3.5	2.9	2.3	1.6	1.7	1.8	1.8	2.15	2.9	2.7
8	3.7	3.45	3.5	2.9	2.3	1.6	1.75	1.8	1.8	2.15	3.0	2.9
9	3.7	3.4	3.55	2.8	2.2	1.55	1.7	1.7	1.85	2.25	3.0	2.9
10	3.7	3.4	3.7	2.6	2.05	1.55	1.9	1.8	1.9	2.2	3.0	2.9
11	3.7	3.4	3.75	2.6	1.8	1.55	2.0	1.8	1.9	2.2	3.0	2.9
12	3.65	3.45	3.8	2.6	1.7	1.55	2.0	1.8	1.9	2.25	3.0	2.9
13	3.65	3.45	3.8	2.8	1.9	1.6	1.95	1.85	1.9	2.4	3.0	2.9
14	3.6	3.45	3.8	2.85	2.2	1.6	1.6	1.8	1.9	2.45	3.0	2.8
15	3.6	3.45	3.75	2.9	2.35	1.6	1.6	1.8	1.9	2.55	3.0	2.75
16	3.5	3.4	3.7	3.0	2.35	1.6	1.6	1.8	1.9	2.7	3.0	2.65
17	3.6	3.45	3.65	3.1	2.35	1.6	1.6	1.8	1.95	2.9	2.9	2.7
18	3.65	3.4	3.6	3.15	2.65	1.6	1.6	1.8	1.9	3.25	2.9	2.65
19	3.7	3.4	3.6	2.9	2.2	1.6	1.7	1.8	1.9	3.2	2.9	2.65
20	3.7	3.4	3.6	2.8	2.15	1.6	1.7	1.7	1.9	3.2	2.85	2.6
21	3.65	3.4	3.6	.....	2.1	1.6	1.7	1.7	2.0	3.15	2.85	2.6
22	3.6	3.3	3.6	.....	2.55	1.6	1.7	1.7	2.0	3.15	2.9	.....
23	3.7	3.2	3.6	.....	2.75	1.6	1.7	1.75	2.1	3.2	2.8	.....
24	3.8	3.35	3.6	.....	2.75	1.6	1.7	1.85	2.1	3.2	2.75	.....
25	3.9	3.45	3.55	2.1	2.5	1.6	1.7	1.85	1.85	3.2	2.7	2.8
26	3.8	3.5	3.6	2.0	2.4	1.6	1.7	1.85	1.8	3.15	2.7	2.8
27	3.7	3.5	3.5	1.9	2.3	1.6	1.7	1.85	1.8	3.2	2.8	2.8
28	3.7	3.5	3.4	1.9	2.2	1.6	1.7	1.85	2.0	3.4	2.9	2.8
29	3.7	.....	.....	1.85	2.3	1.6	1.7	1.85	2.05	3.4	2.85	2.8
30	3.6	.....	3.3	2.0	2.0	1.6	1.7	1.85	1.85	3.4	2.85	2.8
31	3.7	.....	3.5	.....	1.9	.....	1.7	1.85	.....	3.4	.....	2.8

NOTE.—Ice Jan. 1 to 5.

Daily discharge, in second-feet, of South Platte River near Kersey, Colo., for 1910.

[Gauge No. 2.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	615	535	477	103	67	39	39	49	53	390	245
2	.....	595	535	458	121	67	39	39	49	53	390	260
3	.....	575	535	420	220	43	39	39	49	98	390	200
4	.....	535	535	385	439	43	39	39	49	82	390	173
5	.....	535	535	439	282	40	39	42	49	82	390	173
6	595	535	535	315	166	43	39	53	45	82	245	173
7	615	515	535	315	142	43	39	45	45	82	260	200
8	615	515	535	315	142	43	42	45	45	82	290	260
9	615	496	555	282	121	40	39	39	49	98	290	260
10	615	496	615	220	95	40	53	45	53	89	290	260
11	615	496	635	220	61	40	63	45	53	89	290	260
12	595	515	655	220	51	40	63	45	53	98	290	260
13	595	515	655	282	73	43	58	49	53	126	290	260
14	575	515	655	298	121	43	34	45	53	137	290	230
15	575	515	635	315	154	43	34	45	53	160	290	215
16	535	496	615	350	154	43	34	45	53	200	290	186
17	575	515	595	385	154	43	34	45	58	260	260	200
18	595	496	575	402	235	43	34	45	53	372	260	186
19	615	496	575	315	121	43	39	45	53	355	260	186
20	615	496	575	282	112	43	39	39	53	355	245	173
21	595	496	575	250	103	43	39	39	63	338	245	173
22	575	458	575	192	206	43	39	39	63	338	260	173
23	615	420	575	142	266	43	39	42	75	355	230	200
24	655	477	575	121	266	43	39	49	75	355	215	230
25	697	515	555	103	192	43	39	49	49	355	200	230
26	655	535	575	87	166	43	39	49	45	338	200	230
27	615	535	535	73	142	43	39	49	45	355	230	230
28	615	535	496	73	121	43	39	49	63	428	260	230
29	615	.....	477	67	142	43	39	49	69	428	245	230
30	575	.....	458	87	87	43	39	49	49	428	245	230
31	615	.....	535	.....	73	.....	39	49	.....	428	.....	230

NOTE.—These discharges were obtained from rating curves applicable as follows: Jan. 6 to June 30, not well defined; July 1 to Dec. 31, poorly defined. Discharge interpolated for days when gage was not read.

Monthly discharge of South Platte River near Kersey, Colo., for 1910.

[Drainage area, 9,470 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	[a] 1,020	0.108	0.12	62,700	C.
February	1,020	758	858	.091	.09	47,700	C.
March	1,160	746	964	.102	.12	59,300	C.
April	797	126	419	.042	.05	24,900	C.
May	609	104	237	.025	.03	14,600	C.
June	126	90	97.3	.010	.01	5,790	C.
July	130	93	100	.011	.01	6,150	C.
August	120	98	106	.011	.01	6,520	C.
September	142	101	114	.012	.01	6,780	C.
October	585	112	356	.038	.04	21,900	C.
November	547	304	421	.044	.05	25,100	C.
December	.....	.....	335	.035	.04	20,600	C.
The year	.....	.....	419	.044	.58	302,000	

[a] Discharge for Jan. 1 to 5 channel No. 1 estimated as 373 second-feet; channel No. 2 estimated as 595 second-feet, because of ice conditions.

NOTE.—These estimates are for the combined flow in the two channels.

SOUTH PLATTE RIVER AT JULESBURG, COLO.

This station, which is located 1 mile south of Julesburg, Colo., in T. 12 N., R. 44 W., below all irrigation ditches taking water from the South Platte in Colorado except one, was established April 2, 1902, but was not in operation during 1907. It was reestablished on May 2, 1908, at a new pile bridge about 2,000 feet upstream from the old location.

The greatest value of this station lies in the fact that it is situated less than a mile from the Colorado-Nebraska line, and its records, therefore, show the amount of water passing into Nebraska. It has also some importance in obtaining data on the flow of return waters.

All the tributaries for 100 miles or more above the station are intermittent streams and none are of any importance. The same may be said of the tributaries between Julesburg and North Platte, where the river joins North Platte River to form the Platte. The drainage area at Julesburg is 20,600 square miles. Numerous irrigation systems and reservoirs are located on the South Platte and tributaries above Julesburg for a distance of 250 miles. In 1907 more than 900,000 acres were irrigated in this valley. Nearly 450,000 acre-feet were stored in reservoirs, and over half of this quantity was used for irrigation in that year. Additional rights can not be provided for in the South Platte Valley without constructing reservoirs to store surplus flood waters.

The flow of the river at Julesburg during the irrigation season depends on the amount of water diverted above and is likely to be small except when the river is in flood. During the nonirrigating season considerable water is diverted by feeder canals to storage reservoirs from the main river or its tributaries or is intercepted by reservoirs on the tributaries.

The river is usually frozen over wholly or in part for two or three months during the winter.

A chain and a rod are fastened to the upstream side of the bridge. These gages are in no way referred to the old gage. No change has been made in datum of gage since 1908. However, the recorded gage heights give no indication of the discharge of the river from one season to the next because of the sandy and extremely shifting character of the stream bed. In low water the river consists of a number of small rivulets flowing between sand bars. In order to procure reliable results measurements should be taken as often as once every two weeks throughout the year. They are made from the bridge at high stages and by wading when the river is low.

Discharge measurements of South Platte River at Julesburg, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 11[a]	G. H. Russell	466	525	[b] 2.95	1,031
Mar. 22	do	431	334	2.23	670
Apr. 26	do	229	109	1.80	169
May 17	do	98	30	1.40	33
June 10	do	73	21	1.30	22
July 15	do	34	6	1.20	5
Aug. 10	do	50	13	1.31	11
Sept. 13	do	52.5	11	1.30	13
Sept. 30	do	76	20	1.41	22
Oct. 28[c]	do	69	21	1.55	21
Nov. 25	Padgett and Miles	43.5	17	1.40	22
Dec. 28[d]	E. O. Christiansen	181	143	2.04	234

[a] Measurement made through ice and by wading.
[b] Gage probably taken to bottom of ice.
[c] Some thin ice in measuring section.
[d] Made 1½ miles below bridge by wading. Slush ice in channels.

NOTE.—All measurements in 1910 were made by wading at various sections.

Daily gage height, in feet, of South Platte River at Julesburg, Colo., for 1910.

[J. G. McSparran and Elva McSparran, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.7	3.2	2.25	1.6	1.25	1.1	1.4	1.35	.....	1.4	1.4
2	3.7	3.7	3.2	2.2	1.6	1.25	1.1	1.45	1.35	1.4	1.4	1.5
3	3.8	3.7	3.0	2.0	1.55	1.2	1.1	1.4	1.35	1.4	1.4	1.5
4	3.8	3.7	2.5	2.1	1.55	1.2	1.1	1.4	.....	1.4	1.4	1.5
5	3.8	3.7	2.4	2.2	1.6	1.2	1.1	1.35	1.35	1.4	1.4	1.5
6	3.8	3.6	2.4	2.1	1.6	1.25	1.1	1.4	1.35	1.4	1.4	1.6
7	3.8	3.55	2.4	2.05	1.6	1.25	1.1	1.35	1.4	1.4	1.4	1.7
8	3.8	3.55	2.5	2.0	1.6	1.2	1.1	1.35	1.35	1.4	1.4	1.7
9	3.8	.....	2.3	2.0	1.55	1.2	1.1	1.35	1.35	1.4	1.4	1.7
10	3.8	.....	2.3	2.0	1.55	1.25	1.1	1.35	1.35	1.4	1.4	1.7
11	3.8	3.4	[a] 4.75	2.0	1.5	1.2	1.1	1.35	1.35	1.4	1.4	2.0
12	3.8	3.4	2.7	1.95	1.45	1.2	1.1	1.3	1.35	1.4	1.4	2.0
13	3.8	.....	2.4	1.9	1.45	1.2	1.15	1.35	1.3	1.4	1.4	2.1
14	3.8	.....	2.5	1.95	1.4	1.2	1.15	1.35	1.3	1.4	1.4	2.1
15	3.8	.....	2.4	2.0	1.4	1.25	1.1	1.35	1.3	1.4	1.3	2.1
16	3.8	.....	2.3	2.0	1.4	1.2	1.1	1.35	1.3	1.4	1.3	2.2
17	3.8	3.4	2.3	1.9	1.3	1.2	1.1	1.35	1.3	1.4	1.3	2.2
18	3.8	3.45	2.3	1.8	1.3	1.2	1.1	1.35	1.3	1.4	1.3	2.2
19	3.8	3.4	2.2	1.8	1.35	1.1	1.1	1.35	1.3	1.4	1.3	2.1
20	3.8	3.4	2.2	1.75	1.35	1.1	1.1	1.35	1.3	1.4	1.3	2.1
21	3.8	3.5	2.2	1.7	1.3	1.1	1.1	1.35	1.3	1.4	1.3	2.2
22	3.8	3.6	2.2	1.75	1.3	1.1	1.25	1.35	1.3	1.4	1.3	2.2
23	3.8	3.55	2.2	1.75	1.3	1.1	1.3	1.35	1.4	1.4	1.3	2.2
24	3.8	3.6	2.2	1.75	1.3	1.1	1.3	1.35	1.4	1.4	1.3	2.2
25	3.8	3.6	2.1	1.65	1.35	1.1	1.3	1.4	1.4	1.4	1.3	2.2
26	3.8	3.5	2.0	1.6	1.35	1.1	1.3	1.35	1.4	1.4	1.3	2.2
27	3.75	3.4	2.1	1.6	1.3	1.1	1.3	1.35	1.4	1.4	1.3	2.2
28	3.75	3.3	2.2	1.65	1.3	1.1	1.35	1.4	1.35	1.4	1.3	2.1
29	3.75	.....	2.15	1.6	1.3	1.1	1.4	1.35	1.4	1.4	1.4	2.1
30	3.75	.....	2.2	1.6	1.3	1.1	1.4	1.35	1.4	1.4	1.4	2.2
31	3.7	.....	2.25	.....	1.25	.....	1.4	1.35	.....	1.4	.....	2.2

[a] High gage height due to bursting of Julesburg Reservoir. Maximum recorded gage height was 5.70 feet at 11 a. m.

NOTE.—Ice probably lasted from Jan. 1 to about Feb. 16. The gage heights Feb. 17 to Mar. 3 are abnormally high, and may be affected by backwater. Probable ice conditions from about Dec. 11 to 31. Gage heights Nov. 15 to 28 believed to be about 0.1 foot too small, owing to water being away from gage.

Daily discharge, in second-feet, of South Platte River at Julesburg, Colo., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	682	87	16	1	23	18	23	23	23
2	.....	605	87	16	1	32	18	23	23	40
3	.....	358	72	11	1	23	18	23	23	40
4	1,150	472	72	11	1	23	*a* 18	23	23	40
5	938	605	87	11	1	18	18	23	23	40
6	938	472	87	16	1	23	18	23	23	65
7	938	415	87	16	1	18	23	23	23	100
8	1,150	358	87	11	1	18	18	23	23	100
9	758	358	72	11	1	18	18	23	23	100
10	758	358	72	16	1	18	18	23	23	100
11	12,900	358	57	11	1	18	18	23	23	.....
12	1,660	310	46	11	1	12	18	23	23	.....
13	938	263	46	11	2	18	12	23	23	.....
14	1,150	310	36	11	2	18	12	23	23	.....
15	938	358	36	10	1	18	12	23	23	.....
16	758	358	36	10	1	18	12	23	23	.....
17	758	263	21	10	1	18	12	23	23	.....
18	758	187	21	10	1	18	12	23	23	.....
19	605	187	28	3	1	18	12	23	23	.....
20	605	158	28	3	1	18	12	23	23	.....
21	605	129	21	3	1	18	12	23	23	.....
22	605	158	21	3	8	18	12	23	23	.....
23	605	158	21	3	12	18	23	23	23	.....
24	605	158	21	3	12	18	23	23	23	.....
25	472	108	28	3	12	23	23	23	23	.....
26	358	87	28	2	12	18	23	23	23	.....
27	472	87	21	2	12	18	23	23	23	.....
28	605	108	21	2	18	23	18	23	23	.....
29	538	87	21	2	23	18	23	23	23	.....
30	605	87	21	2	23	18	23	23	23	.....
31	682	.....	16	.....	23	18	.....	23	.....	.....

a Interpolated.

NOTE.—These discharges are based on rating tables applicable as follows: Mar. 4 to June 10, fairly well defined between 30 and 5,000 second-feet; June 11 to July 15, indirect method for shifting channels used; July 16 to Dec. 31, fairly well defined. Discharge Nov. 15 to 28 interpolated.

Monthly discharge of South Platte River at Julesburg, Colo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
Mar. 4–31	12,900	358	1,210	67,200	C.
April	682	87	287	17,100	B.
May	87	16	45.3	2,790	B.
June	16	2	8.33	500	C.
July	23	1	5.74	353	D.
August	32	12	19.2	1,180	C.
September	23	12	17.3	1,030	C.
October	23	23	23.0	1,410	C.
November	23	12	23.0	1,370	C.
December *a*	.....	23	151.	9,280	D.
The period	.....	.....	.....	102,000	

a Estimated mean discharge. Dec. 11 to 15, 140 second-feet; Dec. 16 to 20, 180 second-feet; Dec. 21 to 25, 210 second-feet; Dec. 26 to 31, 230 second-feet.

TARRYALL CREEK BASIN.

DESCRIPTION.

Tarryall Creek rises in the Rocky Mountain Front Range near Breckenridge Pass, above Como, Colo., at an elevation of almost 11,000 feet above sea level, and flows in a general southeasterly

direction to its junction with South Platte River, about 5 miles above the upper end of Lake Cheesman, at an elevation of 7,500 feet above sea level. The important tributaries from the north are Michigan, Jefferson, and Rock creeks; those from the south are Park Gulch and Early Gulch. The creek flows in Park County except for 3 or 4 miles at the mouth, which is in Jefferson County. Its drainage area comprises approximately 550 square miles.

The upper half of the valley of Tarryall Creek is fairly broad and of gentle slope; the lower end of the valley, between the Tarryall Mountains on the north and the Puma Hills on the south, is comparatively narrow and its slopes are steeper.

Some irrigation is carried on in the upper end of the basin, but only a small quantity of water is diverted from the stream. Hay is the principal crop raised.

At the end of the basin near the Continental Divide are forests composed chiefly of Douglas fir and pine; the lower end of the basin is only slightly covered with forest. The drainage basin is in the dry belt, the average annual run-off ranging from 10 to 15 inches over the entire area.

TARRYALL CREEK NEAR JEFFERSON, COLO.

This station, which is located at the L. W. Robbins ranch, 10 miles below Jefferson, a station on the Colorado & Southern Railway, was established October 23, 1910. The station is just above the mouth of Rock Creek and 1 mile below mouth of Jefferson Creek.

A vertical rod gage is attached to L. W. Robbins's private bridge in his field one-fourth mile from road.

Measurements are made from bridge to which gage is attached and by wading at various sections.

The bed of stream is of gravel and sand with shifting tendency.

This is not a regular station as there is no daily gage observer.

This station was maintained in cooperation with the United States Forest Service.

The following discharge measurement was made by S. T. Harding:

October 18, 1910: Width, 15 feet, area 11 square feet; gage height, 0.85 foot; discharge, 11 second-feet.

The following additional gage heights were observed by R. M. Truman:

November 1, 0.9 foot; November 10, 0.8 foot.

TARRYALL CREEK NEAR HAYMAN, COLO.

This station was established October 23, 1910, by the United States Geological Survey in cooperation with the United States Forest Service and is being maintained as a cooperative station. It is located in T. 11 S., R. 72 W., on a private bridge 20 feet inside of

field at gate, at McLaughlin's ranch, three-eighths mile downstream from sawmill and one-quarter mile up from ranch house, 8 miles from Lake George, Colo.

A vertical staff gage is attached on right downstream abutment, just under bridge floor.

Measurements are made by wading or from bridge. The measuring section is fair.

The channel is of sand and gravel and only slightly shifting.

Gage heights are affected by ice during the winter months.

Discharge measurements of Tarryall Creek near Hayman, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Oct. 23.	S. T. Harding	22	18	0.80	9.3
Nov. 18.	G. H. Russell	20	13	.9	13.3

NOTE.—The following additional gage heights, in feet, were observed by F. C. Parrett:

Date.	Gage height.	Date.	Gage height.	Date.	Gage height.	Date.	Gage height.
Oct. 27	0.8	Nov. 13	0.9	Nov. 29	1.0	Dec. 15	0.8
Oct. 30	.75	Nov. 22	.85	Dec. 6	1.1	Dec. 22	.7
Nov. 5	1.0	Nov. 23	.8	Dec. 7	1.0	Dec. 29	.6
Nov. 12	.9						

JEFFERSON CREEK AT JEFFERSON, COLO.

This station, which is located at Jefferson, just below the Colorado & Southern Railway bridge, was established October 17, 1910.

A rod gage is located on the left bank 100 feet below the highway bridge. Measurements are made by wading at different sections.

The bed of the stream is sandy and shifting. The creek is frozen over from three to four months each year.

This station is maintained in cooperation with the United States Forest Service.

The following discharge measurement was made by S. T. Harding:

October 17, 1910: Width, 6 feet; area, 1.4 square feet; gage height, 0.4 foot; discharge, 1.2 second-feet.

The following additional gage heights were observed by R. M. Truman:

October 17, 0.35 foot; October 30, 0.4 foot; November 10, 0.4 foot; November 28, 0.3 foot; December 19, 1.3 feet.

MICHIGAN CREEK NEAR JEFFERSON, COLO.

Michigan Creek is tributary to Jefferson Creek.

This gaging station, which is located 3 miles southwest of Jefferson, was established October 17, 1910.

A vertical gage is attached to the highway bridge. Measurements are made from bridge and by wading at various sections.

The bed of the stream is sandy and shifting. The stream is frozen from three to four months each year.

The following discharge measurement was made by S. T. Harding:

October 17, 1910: Width, 8 feet; area, 6.2 square feet; gage height, 0.70 foot; discharge, 5.9 second-feet.

The following additional gage heights were observed by R. M. Truman:

October 31, 0.8 foot; November 11, 0.85 foot; November 26, 0.7 foot.

BASIN OF NORTH FORK OF SOUTH PLATTE RIVER.

NORTH FORK OF SOUTH PLATTE RIVER AT GRANT, COLO.

This station, which is located at Grant, about 250 feet above the junction of Geneva Creek with the North Fork of South Platte River, was established July 18, 1910.

A vertical gage is located on left bank, 20 feet above foot log. Measurements are made from foot log and by wading at various sections.

The bed of the stream is of small bowlders and is liable to shift during high stages.

The stream is affected by ice for about three months each year.

This station is maintained in cooperation with the United States Forest Service.

Discharge measurements of North Fork of South Platte River at Grant, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 18[a]	J. B. Stewart	16.7	11.9	1.51	16.0
Aug. 29	W. B. Freeman	14	7.9	1.35	8.9
Sept. 19	do	14	8.6	1.42	11.0
Nov. 19[a]	do	12	8.4	1.43	8.5
Dec. 15[a]	J. B. Stewart	8	5.1	[b] 1.50	6.6

[a] Measurements made by wading. [b] Gage height distorted by ice.

Daily gage height, in feet, of North Fork of South Platte River at Grant, Colo., for 1910.

[Edmund Couch, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.55				1.5	16		1.4				1.6
2							17						
3		1.5			1.25		18	1.5	1.4			1.4	
4							19			1.42		1.43	
5							20		1.4	1.45			1.65
6		1.5					21				1.45		
7							22						
8			1.35				23	1.5	1.4				
9							24						
10						1.6	25				1.35	1.45	
11			1.35	1.45	1.25		26		1.35				
12		1.45					27	1.45			1.25		
13							28		1.35				
14							29		1.35	1.4			
15					1.45	1.5	30						
							31						

NOTE.—Gage heights after Nov. 19 somewhat distorted by ice.

Daily discharge, in second-feet, of North Fork of South Platte River at Grant, Colo., for 1910.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1		19	8.7	10	6.6	16		10	10	12.5	12.5
2		15	8.7	10	6.6	17		10	10	12.5	10
3		15	8.7	10	6.6	18	15	10	10	12.5	10
4		15	8.7	10	6.6	19	15	10	11	12.5	8.5
5		15	8.7	10	6.6	20	15	10	12.5	12.5	
6		15	8.7	12.5	6.6	21	15	10	12.5	12.5	
7		15	8.7	12.5	6.6	22	15	10	12.5	12.5	
8		15	8.7	12.5	6.6	23	15	10	12.5	10	
9		15	8.7	12.5	6.6	24	15	10	12.5	8.7	
10		12.5	8.7	12.5	6.6	25	15	10	12.5	8.7	
11		12.5	8.7	12.5	6.6	26	12.5	8.7	12.5	7.4	
12		12.5	8.7	12.5	7.4	27	12.5	8.7	12.5	6.6	
13		12.5	8.7	12.5	8.7	28	12.5	8.7	10	6.6	
14		10	8.7	12.5	10	29	15	8.7	10	6.6	
15		10	10	12.5	12.5	30	19	8.7	10	6.6	
						31	23	8.7		6.6	

NOTE.—These discharges are based on a fairly well defined rating curve. Discharges interpolated for days on which gage was not read.

Monthly discharge of North Fork of South Platte River at Grant, Colo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
July 18–31	23	12.5	15.3	424
August	19	8.7	11.7	719
September	12.5	8.7	10.1	601
October	12.5	6.6	10.6	652
November	12.5		[a] 8.08	481
December			[a] 6.8	418

[a] Discharges Nov. 20 to Dec. 31, estimated because of ice.

NOTE.—These estimates are approximate.

NORTH FORK OF SOUTH PLATTE RIVER AT CASSELLS, COLO.

This station, which is located at a private highway bridge at Cassells, Colo., was established July 4, 1908, to determine the value of the stream for power development.

Geneva Creek, one of the most important tributaries, comes in about 2 miles above, and supplies a large part of the water passing the station.

The drainage area above the basin comprises 100 square miles, a considerable part of which is timbered. No diversions of any importance are made above this point on the main stream or any of its tributaries, but many filings have been made for power sites, especially on Geneva Creek. Additional power sites are, however, probably available.

The stream is liable to freeze over from the middle of November to the 1st of April.

No change has been made in the datum of the gage since it was first established. The vertical rod gage originally installed was replaced in December, 1908, by a chain gage on the bridge.

Very good results should be obtained except in extremely high water. Measurements can be taken by wading the greater part of the year, those at the higher stages being taken from the bridge. Frequent measurements are necessary to determine the winter flow accurately.

Discharge measurements of North Fork of South Platte River at Cassells, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan 30	W. B. Freeman	15.3	27.9	[1] 1.90	34.1
Feb. 1	do	14.5	21.4	[1] 1.50	27.2
1	do	13.5	22.6	[1] 1.55	30
25	do	13	19.1	[1] 1.50	22.8
25	do	14	20.5	[1] 1.65	23.2
Mar. 28	do	36.3	30	[1] 1.20	61
30	do	22	16.6	[1] 1.00	24.4
30	do	30.5	31.2	[1] 1.45	71
May 11	do	48	46	1.56	126
11	do	48	45	1.57	116
30	do	29	66	1.75	176
July 18	do	18.5	24	1.41	60
Aug. 27	do	23.5	20.1	1.17	36.2
28	do	27.7	43	1.17	30.4
Sept. 18	do	23.5	21.6	1.21	35.8
18	do	15.1	12.2	1.21	32.5
Nov. 18	do	26	18.3	[a] 1.25	28.8
Dec. 14	J. B. Stewart	16	10.9	[a] 1.27	19.5

[a] Gage heights more or less affected by ice.

NOTE.—All measurements made by wading at various sections except those on May 30 and Aug. 28, when they were made from the bridge.

Daily gage height, in feet, of North Fork of South Platte River at Cassells, Colo., for 1910.

[Lulu Cassell, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.25	1.5	1.4	1.1	1.55	1.9	1.45	1.5	1.1	1.2	1.1	1.25
2	1.25	1.25	1.4	1.15	1.3	1.9	1.45	1.4	1.1	1.2	1.1	1.2
3	1.25	1.3	1.6	1.15	1.4	1.9	1.45	.....	1.1	1.15	1.1	1.3
4	1.3	1.25	1.55	1.0	1.6	1.9	1.45	.....	1.15	1.15	1.1	1.1
5	1.2	1.25	1.6	1.1	1.55	1.9	1.4	.....	1.1	1.2	1.05	1.15
6	1.2	1.25	1.6	1.15	1.4	1.9	1.4	.....	1.1	1.15	1.05	1.1
7	1.2	1.25	1.55	1.15	1.5	1.9	1.4	.....	1.1	1.2	1.15	1.2
8	1.2	1.25	1.5	1.1	1.5	1.85	1.4	.....	1.05	1.2	1.15	1.2
9	1.3	1.25	1.4	1.1	1.55	1.75	1.4	.....	1.1	1.2	1.1	1.2
10	1.45	1.25	1.1	1.3	1.55	1.75	1.45	.....	1.1	1.15	1.15	1.2
11	1.55	1.2	1.2	1.2	1.6	1.7	1.4	1.2	1.1	1.15	1.1	1.25
12	1.45	1.25	1.1	1.2	1.5	1.7	1.4	.....	1.15	1.15	1.1	1.2
13	1.55	1.25	1.1	1.25	1.6	1.75	1.4	.....	1.2	1.2	1.05	1.15
14	1.5	1.25	1.1	1.0	1.6	1.65	1.35	.....	1.35	1.2	1.1	1.15
15	1.75	1.2	1.05	1.1	1.6	1.7	1.35	.....	1.2	1.2	1.0	1.2
16	1.75	1.1	1.1	1.05	1.65	1.6	1.35	.....	1.15	1.2	1.1	1.2
17	1.75	1.2	1.1	1.1	1.6	1.65	1.35	.....	1.2	1.35	1.0	1.25
18	1.6	1.25	1.15	1.2	1.5	1.65	1.35	.....	1.2	1.2	1.15	1.3
19	1.6	1.25	1.1	1.15	1.55	1.55	1.35	.....	1.3	1.2	1.2	1.2
20	1.55	1.25	1.05	1.15	1.5	1.6	1.25	.....	1.3	1.2	1.1	1.2
21	1.6	1.25	1.15	1.1	1.65	1.6	1.3	.....	1.3	1.2	1.25	1.2
22	1.6	1.4	1.2	1.2	1.55	1.5	1.2	.....	1.25	1.25	1.25	1.2
23	1.55	1.5	1.15	1.25	1.5	1.55	1.3	.....	1.25	1.2	1.2	1.2
24	1.55	1.6	1.15	1.3	1.55	1.65	1.25	.....	1.2	1.2	1.15	1.3
25	1.55	1.55	1.1	1.4	1.6	1.6	1.25	1.2	1.2	1.15	1.2	1.4
26	1.25	1.5	1.2	1.55	1.65	1.6	1.2	.....	1.2	1.05	1.15	1.35
27	1.3	1.55	1.2	1.6	1.65	1.55	1.2	1.15	1.2	1.1	1.1	1.4
28	1.5	1.45	1.15	1.6	1.65	1.55	1.4	1.15	1.15	1.0	1.1	1.45
29	1.4	.....	1.1	1.7	1.85	1.55	1.6	1.15	1.2	1.05	1.1	1.5
30	1.65	.....	1.25	1.6	1.75	1.5	1.75	1.1	1.15	1.1	1.15	1.5
31	1.65	.....	1.1	.....	1.85	.....	1.5	1.1	.....	1.1	.....	1.6

NOTE.—Ice Jan. 1 to about Mar. 14, and about Nov. 18 to Dec. 31. Thickness of ice Jan. 30, 1.5 feet; Feb. 16, 2 feet; ice breaking up Mar. 3; ice all gone from gage Mar. 15.

Daily discharge, in second-feet, of North Fork of South Platte River at Cassells, Colo., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	46	119	214	78	72	25	35	25
2	.....	53	74	214	78	58	25	35	25
3	.....	53	90	214	78	58	25	30	25
4	.....	34	130	214	75	58	30	30	25
5	.....	46	119	214	67	58	25	35	20
6	.....	53	90	214	67	46	25	30	20
7	.....	53	108	214	67	46	25	35	30
8	.....	46	108	198	63	46	20	35	30
9	.....	46	119	168	63	35	25	35	25
10	.....	74	119	168	70	35	25	30	30
11	.....	60	130	154	63	35	25	30	25
12	.....	60	108	154	60	35	30	30	25
13	.....	67	130	168	60	35	35	35	26
14	.....	34	130	138	54	35	52	35	25
15	40	46	130	150	54	35	35	35	16
16	46	40	142	126	52	35	30	35	25
17	46	46	130	138	52	35	35	52	16
18	53	60	108	132	52	35	35	35	.....
19	46	53	119	110	52	35	46	35	.....
20	40	53	108	120	40	35	46	35	.....
21	53	46	142	120	46	35	46	35	.....
22	60	60	119	96	35	35	40	40	.....
23	53	67	108	105	46	35	40	35	.....
24	53	74	119	126	40	35	35	35	.....
25	46	90	130	115	40	35	35	30	.....

Daily discharge, in second-feet, of North Fork of South Platte River at Cassells, Colo., for 1910—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
26	60	119	142	110	35	35	35	20	.....
27	60	130	142	100	35	30	35	25	.....
28	53	130	142	100	58	30	30	16	.....
29	46	154	198	100	88	30	35	20	.....
30	67	130	168	86	118	25	30	25	.....
31	46	.....	198	.....	72	25	.....	25	.....

NOTE.—These discharges are based on rating curves applicable as follows: Mar 15 to June 10, poorly defined; June 11 to July 17, indirect method for shifting channels used; July 18 to Nov. 17, poorly defined. Discharges estimated Aug. 3 to 10, 12 to 24, and 26.

Monthly discharge of North Fork of South Platte River at Cassells, Colo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	[a] 37.4	2,300	D.
February	.....	.....	[a] 26.8	1,490	D.
March	.....	.....	[a] 46.1	2,830	D.
April	154	34	67.4	4,010	D.
May	198	74	126	7,750	C.
June	214	86	149	8,870	C.
July	118	35	60.0	3,690	C.
August	.....	.....	39.1	2,400	C.
September	52	20	32.7	1,950	B.
October	52	16	32.0	1,970	B.
November	.....	.....	[a] 25.7	1,530	C.
December	.....	.....	[a] 20.8	1,280	D.
The year	214	.....	55.4	40,100	

[a] Discharge estimated because of ice conditions Jan. 1 to Mar. 14 and Nov. 18 to Dec. 31 on the basis of discharge measurements made during these periods.

NORTH FORK OF SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

This station, which was established January 4, 1909, to show the total run-off of the creek available for power and storage and, in connection with the records at the station on the South Fork of the South Platte, to serve as a check on the South Platte station below the forks, is located about one-third mile from the mouth of the stream. The station is maintained in cooperation with the Denver Power & Irrigation Co.

Many ice and fish ponds divert water for a distance of 30 miles above the station.

The drainage area above the station is about 450 square miles.

Measurements are made from a cable 100 yards upstream from the inclined rod gage and by wading. The channel is quite shifting in character and the results obtained have not been very satisfactory. Ice affects the gage heights for several months during the winter. The datum has remained constant since the station was established.

The station was discontinued September 30, 1910.

Discharge measurements of North Fork of South Platte River at South Platte, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 24[a]	G. H. Russell	19	22	3.50	85
Feb. 15[a]	do	23	20	2.95	56
Apr. 2	do	34	35	2.15	104
Apr. 27	do	61	71	2.84	217
May 9	W. B. Freeman	61	71	2.81	223
June 4	R. C. Miles	61	97	2.95	364
June 20	G. H. Russell	59	65	2.45	160
July 19	do	34	36	1.88	83
July 24	Christiansen and Grieve	44	42	1.87	96
Aug. 11	G. H. Russell	40.5	36	1.80	84
Aug. 25	Russell and Padgett	38	33	1.63	65
Sept. 24	Miles and Padgett	38	30	1.55	69
Oct. 31	G. H. Russell	28.5	24	1.40	41
Nov. 22	H. D. Padgett	.....	.....	1.45	(b)

[a] Ice conditions. [b] No measurement made.

NOTE.—All measurements by wading at various sections except Apr. 27, June 4, and Oct. 31.

Daily gage height, in feet, of North Fork of South Platte River at South Platte, Colo., for 1910.

[E. H. Jardine, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.65	2.7	2.6	2.1	2.7	3.05	2.25	2.3	1.6
2	2.7	2.6	2.65	2.1	2.7	2.95	2.2	2.25	1.6
3	2.75	2.5	2.6	2.1	2.6	2.95	2.2	2.15	1.6
4	2.65	2.55	2.5	2.05	2.8	2.85	2.1	2.05	1.6
5	2.7	2.7	2.4	2.0	2.7	2.8	2.1	2.1	1.65
6	2.7	2.55	1.95	2.05	2.6	2.8	2.1	2.05	1.5
7	2.8	2.5	1.9	2.05	2.6	2.75	2.1	1.9	1.5
8	2.6	2.5	1.8	2.05	2.6	2.7	2.05	1.85	1.5
9	3.0	2.6	2.0	2.3	2.75	2.5	2.0	1.8	1.45
10	3.1	2.55	2.0	2.3	2.8	2.5	2.05	1.8	1.45
11	3.1	2.5	2.05	2.4	2.7	2.5	2.0	1.75	1.45
12	3.2	2.4	2.1	2.45	2.7	2.5	2.0	1.75	1.5
13	3.2	2.5	2.1	2.45	2.8	2.6	1.95	1.75	1.6
14	2.9	2.6	2.1	2.5	2.7	2.6	1.95	1.75	1.6
15	3.1	2.95	2.05	2.5	2.8	2.6	1.95	1.75	1.55
16	2.0	2.8	2.0	2.45	2.75	2.5	1.95	1.7	1.6
17	3.0	2.75	2.0	2.45	2.8	2.65	1.85	1.65	1.6
18	2.9	2.7	2.0	2.45	2.9	2.5	1.95	1.65	1.6
19	2.9	2.7	2.1	2.45	2.7	2.5	1.9	1.65	1.7
20	3.1	2.6	2.1	2.5	2.7	2.45	1.9	1.65	1.65
21	3.05	2.5	2.0	2.7	2.7	2.35	2.0	1.65	1.6
22	3.05	2.4	2.0	2.55	2.7	2.3	2.15	1.65	1.6
23	3.5	2.4	2.0	2.5	2.95	2.4	1.95	1.65	1.6
24	3.5	2.5	2.05	2.5	2.9	2.4	1.95	1.65	1.55
25	2.8	2.4	1.95	2.7	2.8	2.6	1.85	1.65	1.55
26	2.7	2.4	1.95	2.7	3.0	2.55	1.85	1.65	1.55
27	2.65	2.6	1.95	2.75	2.9	2.65	1.8	1.65	1.55
28	2.7	2.55	1.9	2.7	2.8	2.3	1.85	1.65	1.55
29	2.6	.....	1.9	2.8	3.1	2.2	3.95	1.65	1.55
30	2.75	.....	1.9	2.7	3.2	2.2	2.8	1.6	1.55
31	2.7	.....	2.1	.....	2.95	.....	2.65	1.6	.....

NOTE.—Ice Jan. 1 to Mar. 5.

Daily discharge, in second-feet, of North Fork of South Platte River at South Platte, Colo., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	95	190	380	130	165	60
2	.....	95	190	350	125	155	60
3	.....	95	170	350	125	136	60
4	.....	87	215	325	110	120	60
5	.....	80	190	305	110	127	66
6	78	85	170	305	110	120	50
7	72	85	170	280	110	98	50
8	60	85	170	265	105	92	50
9	85	120	202	210	98	85	45
10	85	120	220	210	105	85	45
11	92	140	200	200	98	78	45
12	98	145	205	200	98	78	50
13	98	145	230	220	90	78	60
14	98	155	210	220	90	78	60
15	92	155	235	220	90	78	55
16	85	140	220	180	92	72	60
17	85	140	240	220	80	66	60
18	85	140	270	180	92	66	60
19	98	140	225	175	90	66	72
20	98	150	225	160	98	66	66
21	85	190	230	145	112	66	60
22	85	160	230	140	136	66	60
23	85	150	310	155	105	66	60
24	92	145	295	155	105	66	55
25	78	190	265	200	92	66	55
26	78	190	340	190	92	66	55
27	78	202	305	210	85	66	55
28	72	190	280	140	92	66	55
29	72	215	380	125	790	66	55
30	72	190	430	125	295	60	55
31	98	.....	340	.....	250	60	.....

NOTE.—These discharges are based on rating tables applicable as follows: Mar. 6 to 31, not well defined; Apr. 1 to 25, and May 10 to July 19, indirect method for shifting channels used; Apr. 26 to May 9, not well defined; July 20 to Sept. 30, fairly well defined between 30 and 150 second-feet.

Monthly discharge of North Fork of South Platte River at South Platte, Colo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	[a] 80.2	4,930	D.
February	.....	.....	[a] 60.4	3,350	D.
March	98	.....	[a] 80.0	4,920	C.
April	215	80	141	8,390	C.
May	430	170	244	15,000	C.
June	380	125	218	13,000	C.
July	790	80	135	8,300	C.
August	165	60	84.6	5,200	B.
September	72	45	56.6	3,370	C.
The period	.....	.....	.....	66,500	

[a] Discharge estimated because of ice Jan. 1 to Mar. 5 on basis of discharge measurements made during this period.

GENEVA CREEK BASIN.

Geneva Creek above Jackwhacker Creek, near Grant, Colo.

A temporary station was established on Geneva Creek, August 17, 1909, to obtain run-off and power data. It is located 100 feet above the mouth of Jackwhacker Creek, 12 miles above Grant, Colo.

The vertical staff gage has remained unchanged in datum and location since the station was established. Discharge measurements are made by wading.

The bed of the stream is made up of small rocks and gravel and is fairly permanent.

The stream is frozen over about four months each year.

This is not a regular station, as there is no daily gage observer.

The following discharge measurement was made by J. B. Stewart:

July 18, 1910: Width, 8 feet; area, 3.1 square feet; gage height, 0.55 foot; discharge, 6.4 second-feet.

The following additional gage heights were observed by Edmund Couch:

July 27, 0.50 foot; August 18, 0.45 foot.

Geneva Creek at Old Geneva smelter, near Grant, Colo.

This is a temporary station, established August 17, 1909, to determine the amount of water available for storage and power development, and is located in T. 6 S., R. 75 W., 10 miles above Grant, Colo.

A vertical rod gage is located on left bank at old slaughterhouse one-fourth mile below the Old Geneva smelter and the same distance below the mouth of Smelter Creek.

Its datum has not been changed since the establishment of the station. Discharge measurements are made by wading.

The bed of the stream is composed of small bowlders and is fairly permanent.

The creek is frozen for three to four months each year.

This is not a regular station, as there is no daily gage observer.

Discharge measurements of Geneva Creek at Old Geneva smelter, near Grant, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 18	W. B. Freeman	16	7.4	1.24	12
Aug. 29	do	16	6.5	1.23	6.3

NOTE.—These measurements made by wading at different sections. The following gage heights were observed by Edmund Couch: July 27, 1.20 feet; August 18, 1.15 feet.

Geneva Creek at Sullivan's ranch, near Grant, Colo.

This station, which is located at Sullivan's ranch, 3½ miles above Grant, Colo., in T. 6 S., R. 74 W., was established July 5, 1908, to obtain data concerning the run-off from a small mountain drainage area and also to determine the flow available for power development.

The station is about 3½ miles above the confluence of Geneva Creek with the North Fork of the South Platte, about 50 feet below the mouth of Gold Run, or Threemile Creek, and about a mile below the mouth of Scott Gomer Gulch, which is called on some of the old

maps the North Fork of the South Platte. The drainage area, which is very mountainous and part of which area is heavily timbered, comprises 49 square miles above the station.

No water is diverted above the station. Several power sites have been filed on, but the stage of construction at none of these has yet been reached. The creek has a fall of 900 feet in the last 4 miles and a very much greater fall above. With proper storage it will be possible to develop 10,000 horsepower during a six months' period. The development of the Continental reservoir site, about 3 miles above the station, is under consideration.

The creek is frozen wholly or in part for four or five months during the year.

The datum or position of the vertical rod gage has not been changed since the station was established.

Very good results should be obtained except at very high stages, when the current is likely to be swift. Measurements can be made by wading at most seasons of the year, but for flood measurements a cable must be installed. Such high-water measurements as there are have been made from the highway bridge at Grant, 3½ miles downstream.

Discharge measurements of Geneva Creek at Sullivan's ranch, near Grant, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 31[a]	W. B. Freeman	16.5	17.4	0.52	15.9
Feb. 25[b]	do	12.3	14	.50	13
Mar. 29	do	20.5	15.8	.50	19.7
May 10	do	41	31	1.00	73
29	do	42	35	1.10	97
July 18	do	30	23.6	.71	35.2
Aug. 29	do	27	17.4	.57	21.4
Sept. 19	do	23.5	23.4	.65	25
Nov. 19[a]	do	19.8	20.2	.62	15.3
Dec. 15	J. B. Stewart	8.0	10.3	[c] 1.08	10.6

[a] Slightly affected by ice. [b] Partly frozen. [c] Gage height distorted by ice.

NOTE.—All measurements made by wading at various sections.

Daily gage height, in feet, of Geneva Creek at Sullivan's ranch, near Grant, Colo., for 1910.

[M. A. Sullivan, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	0.70	0.55				1.3	0.9	0.95	0.55	0.55	
2	.65	.55				1.3	.9	.9	.55	.55	
3	.65	.5				1.3	.9	.85	.6	.55	
4	.65	.5	0.45			1.3	.9	.8	.55	.55	
5	.6	.5	.45			1.2	.9	.8	.55	.55	
6	.6	.55	.5			1.2	.85	.8	.55	.55	
7	.6	.6	.5	0.55		1.1	.85	.75	.55	.5	0.5
8	.6		.8	.55		1.1	.8	.7	.5	.5	.5
9	.6			.6		1.1	.8	.75	.5	.5	.45
10	.6			.6	1.0	1.1	.85	.75	.5	.52	.45

Daily gage height, in feet, of Geneva Creek at Sullivan's ranch, near Grant, Colo., for 1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11				0.65	1.1	1.05	0.8	0.7	0.5	0.55	
12					1.1	1.1	.8	.7	.55	.55	
13					1.1	1.1	.75	.7	.55	.55	
14					1.15	1.1	.7	.7	.65	.55	
15			0.6		1.1	1.1	.7	.7	.65	.55	
16			.6		1.1	1.05	.7	.65	.6		
17					.9	1.0	.7	.6	.55		
18					1.0	1.0	.7	.6	.55		
19					1.0	1.0	.7	.6	.65		
20				.7	.95	1.0	.75	.6	.6		
21				.75	.9	1.0	.7	.65	.6		
22					.9	.95	.75	.65	.6		
23				.7	.95	.95	.7	.65	.6		
24					1.0	.95	.65	.6	.6		
25		0.5			.9	1.0	.65	.6	.6		
26				.8	.95	1.05	.65	.6	.6		
27				.95	1.0	1.0	.65	.6	.6		
28				1.0	1.1	.95	.7	.6	.6		
29			.5	1.0	1.1	.95	.65	.6	.55		
30					1.3	.9	.85	.55	.55		
31	0.5				1.25		1.0	.55			

NOTE.—Probably only slightly affected by ice during January, February, and March, last part of November, and December.

Daily discharge, in second-feet, of Geneva Creek at Sullivan's ranch, near Grant, Colo., for 1910.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	20	75	134	59	67	19	19	
2	20	75	134	59	59	19	19	
3	24	75	134	59	52	23	19	
4	24	75	134	59	45	19	19	
5	23	75	114	59	45	19	19	
6	23	75	114	52	45	19	19	
7	23	75	94	52	39	19	15	15
8	23	75	94	45	33	15	15	15
9	28	75	94	45	39	15	15	12
10	28	75	94	52	39	15	17	12
11	31	94	84	45	33	15	19	
12	31	94	94	45	33	19	19	
13	31	94	94	39	33	19	19	
14	31	104	94	33	33	28	19	
15	31	94	94	33	33	28	19	
16	37	94	84	33	28	23		
17	35	59	75	33	23	19		
18	35	75	75	33	23	19		
19	35	75	75	33	23	28		
20	35	67	75	39	23	23		
21	41	59	75	33	28	23		
22	41	59	67	39	28	23		
23	34	67	67	33	28	23		
24	39	75	67	28	23	23		
25	39	59	75	28	23	23		
26	46	67	84	28	23	23		
27	68	75	75	28	23	23		
28	76	94	67	33	23	23		
29	75	94	67	28	23	19		
30	75	134	59	52	19	19		
31		124		75	19			

NOTE.—These discharges are based on rating curves applicable as follows: Apr. 1 to May 9, indirect method for shifting channels; May 10 to Nov. 10, fairly well defined. Discharges estimated Apr. 1 to 6, 12 to 19, 22, 24, 25, 30, May 1 to 9.

Monthly discharge of Geneva Creek at Sullivan's ranch, near Grant, Colo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January			[a] 20.0	1,230	D.
February			[a] 15.0	833	D.
March			[a] 18.0	1,110	C.
April			37.5	2,230	B.
May			80.9	4,970	B.
June	134	59	89.6	5,330	B.
July	75	28	42.3	2,600	B.
August	67	19	32.5	2,000	B.
September	28	15	20.8	1,240	B.
October			[b] 18.5	1,140	C.
November			[a] 15.0	893	C.
December			[a] 11.0	676	D.
The year			33.4	24,300	

[a] Estimated from discharge measurements and observer's notes.
[b] Oct. 16 to 31, estimated as 19 second-feet.

Smelter Creek near Grant, Colo.

A temporary station on Smelter Creek, in T. 6 S., R. 75 W., about one-fourth mile above its confluence with Geneva Creek, at the old Geneva smelter, 10 miles above Grant, Colo., was established August 17, 1909.

None of the water in this stream has been diverted for any purpose, but some opportunity is presented for power development on account of the precipitous slope of the stream bed.

There has been no change in the location of the vertical staff gage since the station was established. Discharge measurements are made by wading.

The stream is covered with ice and snow for several months during the winter season.

Discharge measurements of Smelter Creek near Grant, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 18	W. B. Freeman	8	2.8	0.63	2.2
Aug. 29	do	2.4	1.6	.57	1.8

NOTE.—These measurements made by wading above wagon bridge. The following additional gage heights were observed by Edmund Couch: July 27, 0.6 foot; August 18, 0.6 foot; August 28, 0.6 foot.

Duck Lake Creek near Grant, Colo.

Duck Lake Creek has a total drainage area of about 8 square miles, at an elevation varying between 9,700 and 13,000 feet.

It is proposed to make a storage reservoir out of Duck Lake, which is about 5 miles above the mouth of the stream, at an elevation of 11,000 feet.

A temporary station was established August 17, 1909, about 50 yards above the confluence of Duck Lake Creek with Geneva Creek, about 7 miles above Grant, Colo.

A vertical staff gage is fastened to the crib abutment of an old bridge, and measurements are taken from a foot log at the gage or by wading.

So far no water has been diverted from this creek, though filings have been made both for power and irrigation projects.

Discharge measurements of Duck Lake Creek near Grant, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 31	W. B. Freeman	7	2.8	.....	1.0
Mar. 29	do	7.8	3.35	0.80	2.0
May 10	do	6.5	4.3	1.00	8.0
July 18	do	7.2	2.9	.82	2.1
Aug. 29	do	2.2	1.6	.71	1.4

NOTE.—The following additional gage heights, in feet, were observed by Edmund Couch:

Date.	Gage height.	Date.	Gage height.	Date.	Gage height.	Date.	Gage height.
July 27	0.75	Aug. 28	0.7	Oct. 25	0.7	Nov. 30	0.65
Aug. 18	.75	Sept. 2	.6	Nov. 18	.7	Dec. 1	.7

Scott Gomer Creek at Sullivan's ranch, near Grant, Colo.

Scott Gomer Creek, an important tributary of Geneva Creek, has a total drainage area of 21 square miles, at elevations ranging from 9,500 to 14,000 feet. As the fall of this creek is large it offers excellent opportunities for power development. At present no water is being diverted from the stream.

A temporary station, with a vertical staff gage, was established on Scott Gomer Creek, 3 miles above its mouth and three-eighths of a mile above the Geneva Power Co.'s dam site, August 16, 1909, to determine the amount of water available for power development.

As the location was very inaccessible, another vertical rod gage was established on September 4, 1909, at the highway bridge, one-fourth mile above the junction of the stream with Geneva Creek. Several small tributaries come in between the two stations, but there are none below the lower one.

The creek is covered with ice and snow for several months each winter. Discharge measurements are made by wading.

Discharge measurements of Scott Gomer Creek at Sullivan's ranch, near Grant, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 31 [a]	W. B. Freeman	8.4	5.0	1.63	6.3
Mar. 29 [b]	do	7.9	4.4	1.23	7.3
May 10	do	18.5	12.8	1.83	19.1
July 18	do	6.8	4.1	1.25	7.2
Aug. 29	do	5.8	3.1	1.16	6.3
Sept. 19	do	6.5	4.9	1.42	7.7

[a] Partly frozen over. [b] Some ice.

NOTE.—The following additional gage heights, in feet, were observed by Edmund Couch:

Date.	Gage height.	Date.	Gage height.	Date.	Gage height.
May 19	1.90	Aug. 18	1.20	Nov. 19	1.42
July 23	1.15	Aug. 28	1.15	Nov. 30	1.25
July 27	1.15	Sept. 2	1.65	Dec. 11	1.30
Aug. 1	1.75	Oct. 25	1.45		
Aug. 6	1.55	Nov. 18	1.20		

NOTE.—On Nov. 19 there was considerable ice in the stream; thickness, 1½ inches.

CLEAR CREEK BASIN.

DESCRIPTION.[1]

Clear Creek is one of the largest tributaries of South Platte River, which it enters about 6 miles below Denver. Like the other streams of this region, it flows for a long distance through a mountainous territory and then passes out to the plains, where its water is used for irrigation, there being comparatively little surplus even during the flood stages.

CLEAR CREEK AT FORKSCREEK, COLO.

For 13 miles below Forkscreek station the creek flows in a deep canyon, falling in that distance 1,225 feet. It then emerges into a broad valley, where the entire normal flow is used for irrigation. The drainage area above Forkscreek station, 345 square miles in extent, comprises a narrow strip of very mountainous country, composed entirely of granitic rock, in many places barren of soil and studded with heavy patches of coniferous timber, remnants of a once extensive forest.

Two of the oldest mining districts in Colorado lie in this basin, and in these districts the waters of the upper tributaries of the stream have been used for mining. The stream now carries in suspension immense quantities of tailings and sediment.

The water is used to some extent for power, and 4,000 horsepower are at present developed by about a dozen small plants. Several other plants are planned or in the course of construction. By utilizing all the storage facilities on the stream above Forkscreek it will

[1] For full description of the basin see Hayden's report of 1875, p. 432; also Report on agriculture by irrigation, Eleventh Census, by F. H. Newell, p. 114.

be possible to develop about 30,000 horsepower for six months during the year and 20,000 more between that point and its mouth.

The natural flow of the stream is more or less affected by storage in various ponds and reservoirs above. The creek is frozen over for three or four months during the winter.

This station, which is located at Forkscreek, Colo., in T. 3 S., R. 71 W., was established May 29, 1899, to determine the amount of water available for irrigation and power development.

This station is at a footbridge a few hundred feet below the mouth of the North Fork. No other important tributaries enter between this fork and the mouth of the stream.

On July 19, 1905, the gage was moved 30 feet upstream from its original location, but it is not likely that the relation of gage heights was materially affected thereby. This last gage, which is a chain gage fastened to the footbridge, is still in use. Very good results should be obtained at this station except in times of high water, when it is very difficult to measure, on account of the swiftness of the current. As the channel is occasionally shifted by floods, new rating curves must from time to time be constructed.

The creek is subject to disastrous floods, due to the heavy rains in summer months, which frequently wash out the tracks of the Colorado & Southern Railway in the bottom of the canyon.

Discharge measurements of Clear Creek at Forkscreek, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 20[a]	G. H. Russell	24	25	4.42	40
Feb. 14[a]	do	15	38	4.90	48
Mar. 26	do	22.5	49	4.28	71
May 21	do	20	82	4.85	285
21	do	20	82	4.85	277
June 13	do	40	107	5.45	495
25	Miles and Turner	39	102	5.2	399
July 23	Miles and Padgett	27	72	4.65	181
Aug. 12	G. H. Russell	21	50	5.10	161
12	do	22	55	5.10	165
Sept. 5	H. D. Padgett	19	44	5.00	135
Oct. 1	do	22	34	5.81	.90
29	G. H. Russell	18	29	5.65	68
Dec. 8[a]	R. C. Miles	19	23	6.35	31

[a] Made by wading. Ice conditions.

Daily gage height, in feet, of Clear Creek at Forkscreek, Colo., for 1910.

[C. W. Hoisington, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.05	4.7	5.85	5.1	5.5	4.85	5.75	5.65	6.25
2	.....	4.15	4.65	5.95	5.1	5.5	4.85	5.75	5.65	6.25
3	.....	4.2	4.65	5.75	5.0	5.4	4.85	5.75	5.65	6.3
4	.....	3.8	4.75	5.85	5.0	5.95	4.95	5.75	5.65	6.25
5	.....	3.85	4.65	5.75	5.0	5.4	5.0	5.75	5.6	6.25
6	3.8	3.9	4.7	5.65	4.9	5.3	5.0	5.75	5.6	6.15
7	3.75	4.05	4.65	5.55	4.85	5.2	5.0	5.75	5.6	6.3
8	3.85	4.1	4.7	5.45	4.8	5.2	4.9	5.75	5.6	6.35
9	3.75	4.2	4.75	5.45	4.8	5.15	4.9	5.75	5.6	6.45
10	3.7	4.15	5.05	5.4	4.75	5.1	4.9	5.75	5.6	6.45

Daily gage height, in feet, of Clear Creek at Forkscreek, Colo., for 1910—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	3.6	4.2	5.15	5.45	4.75	5.1	4.9	5.75	5.6	6.45
12	3.65	4.25	5.15	5.45	4.8	5.05	4.8	5.75	5.7	6.5
13	4.3	4.3	5.05	5.5	4.75	5.0	4.8	5.75	5.8	6.5
14	4.15	4.2	5.05	5.5	4.7	5.0	4.8	5.7	5.9	6.55
15	3.95	4.3	4.95	5.55	4.7	5.0	4.75	5.7	6.0	6.55
16	3.85	3.85	4.95	5.5	4.6	5.0	4.75	5.7	6.0	6.55
17	4.0	4.2	4.85	5.4	4.8	4.9	4.75	5.65	6.0	6.6
18	4.15	4.15	4.95	5.4	4.75	4.9	5.55	5.65	6.1	6.6
19	4.05	4.15	4.85	5.3	4.7	4.9	6.2	5.6	6.1	6.65
20	4.2	4.3	4.85	5.3	4.9	4.9	6.0	5.75	6.1	6.75
21	4.2	4.4	4.85	5.3	4.75	4.9	5.9	5.75	6.2	6.75
22	4.25	4.35	4.95	5.3	4.7	4.9	5.9	5.7	6.2	6.75
23	4.2	4.4	4.9	5.2	4.6	4.9	5.85	5.7	6.2	6.75
24	4.3	4.4	4.9	5.3	4.5	4.85	5.8	5.65	6.2	6.8
25	4.25	4.5	4.9	5.25	4.5	4.85	5.8	5.65	6.2	6.85
26	4.3	4.55	4.9	5.25	4.5	4.85	5.75	5.6	6.2	6.85
27	4.1	4.8	4.9	5.25	4.45	4.85	5.75	5.6	6.2	6.9
28	4.15	4.8	5.1	5.2	5.15	4.85	5.7	5.6	6.2	6.95
29	4.15	4.9	5.35	5.3	5.25	4.85	5.75	5.65	6.2	7.0
30	4.1	4.95	5.75	5.25	5.35	4.85	5.75	5.65	6.2	7.0
31	4.05	.....	5.8	.....	5.3	4.85	.....	5.65	.....	7.05

NOTE.—Ice Jan. 1 to about Mar. 5, and Nov. 12 to Dec. 31.

Daily discharge, in second-feet, of Clear Creek at Forkscreek, Colo., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	48	199	700	351	515	92	80	62
2	.....	58	182	748	351	500	92	80	62
3	.....	63	182	652	310	435	92	80	62
4	.....	29	216	700	310	675	118	80	62
5	.....	32	182	652	310	395	132	80	55
6	29	36	199	604	271	340	132	80	55
7	26	48	182	556	252	280	132	80	55
8	32	52	199	508	234	270	104	80	55
9	26	63	216	508	234	235	104	80	55
10	23	58	330	485	216	205	104	80	55
11	18	63	372	508	216	190	104	80	55
12	20	72	372	508	234	148	80	80	.....
13	80	80	330	532	216	132	80	80	.....
14	58	63	330	532	199	132	80	70	.....
15	40	80	290	556	199	132	72	70	.....
16	32	32	290	532	165	132	72	70	.....
17	43	63	252	485	234	104	72	62	.....
18	58	58	290	485	216	104	300	62	.....
19	48	58	252	439	199	104	555	55	.....
20	63	80	252	439	271	104	430	80	.....
21	63	103	252	439	216	104	350	80	.....
22	72	92	290	439	199	104	320	70	.....
23	63	103	271	394	165	104	270	70	.....
24	80	103	271	439	133	92	225	62	.....
25	72	133	271	416	133	92	200	62	.....
26	80	149	271	416	133	92	155	55	.....
27	52	234	271	416	118	92	130	55	.....
28	58	234	351	394	372	92	95	55	.....
29	58	271	462	439	416	92	100	62	.....
30	52	290	652	416	462	92	90	62	.....
31	48	.....	676	.....	439	92	.....	62	.....

NOTE.—These discharges are based on rating curves applicable as follows: Mar. 6 to July 31 fairly well defined between 50 and 550 second-feet; Aug. 12 to Sept. 17 fairly well defined between 100 and 200 second-feet; Oct. 1 to Nov. 11, fairly well defined between 50 and 150 second-feet.

Monthly discharge of Clear Creek at Forkscreek, Colo., for 1910.

[Drainage area, 345 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January			[a] 40	0.116	0.13	2,460	
February			[a] 45	.130	.14	2,500	
March			[a] 46.6	.135	.16	2,870	C.
April	290	29	94.9	.275	.31	5,650	B.
May	676	182	295	.855	.99	18,100	B.
June	748	394	511	1.48	1.65	30,400	A.
July	462	118	251	.728	.84	15,400	B.
August	675	92	199	.577	.67	12,200	B.
September	555	72	163	.472	.53	9,700	C.
October	80	55	71.1	.206	.24	4,370	B.
November			52.8	.153	.17	3,140	
December			29.4	.085	.10	1,810	
The year			150.0	.434	5.93	109,000	

[a] Discharge estimated for ice conditions Jan. 1 to Mar. 5, and Nov. 12 to 31. The means for January, February, November, and December are only approximate.

CLEAR CREEK AT IDAHO SPRINGS, COLO.

This station, which is located at Idaho Springs, half a block above Miner Street, was established October 8, 1910.

A vertical rod gage is fastened to the right bank, 50 feet above 8-inch sewer outlet on left bank. Measurements are made by wading at various sections.

The bed of the stream is sandy and shifting. The creek is frozen for three or four months each year.

This is not a regular station, as daily gage heights are not recorded.

Discharge measurements of Clear Creek at Idaho Springs, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Oct. 8	S. T. Harding	34	48	0.45	95
Dec. 28	R. C. Miles	33	32	.32	53

NOTE.—The following additional gage heights, in feet, were observed by W. B. Kelso:

Date.	Gage height.	Date.	Gage height.	Date.	Gage height.	Date.	Gage height.
Oct. 10	0.45	Oct. 22	0.40	Nov. 8	0.30	Dec. 1	0.30
Oct. 13	.40	Oct. 23	.40	Nov. 21	.25	Dec. 4	.45
Oct. 15	.40	Oct. 29	.35	Nov. 26	.25	Dec. 10	.25
Oct. 17	.45	Nov. 5	.30	Nov. 28	.45	Dec. 31	.30
Oct. 20	.40						

ST. VRAIN CREEK BASIN.

DESCRIPTION.[1]

St. Vrain Creek and its tributaries receive their supply of water from the eastern slope of that portion of the Front Range lying between Longs Peak and James Peak, a distance of about 30 miles. The general trend of the drainage is northeastward, the St. Vrain flowing at last into South Platte River about 6 miles below the town of Platteville.

The principal tributaries of the St. Vrain are the North and South forks and the Boulder, the South Boulder being an important branch of the latter. The areas drained by the upper portions of these streams are mountainous, the streams flowing through deep and rugged canyons, where the water can be used only for placer mining; leaving the foothills, however, each emerges into a broad and nearly level valley where farming by irrigation is extensively practiced.

ST. VRAIN CREEK AT LYONS, COLO.

This station, which is located one-half mile below Lyons and 300 feet below the junction of the North and South forks of St. Vrain Creek, was maintained under the direction of the United States Geological Survey from 1895 to 1903.[2] Since 1903 it has been maintained more or less continually under the direction of the State engineer's office.

A number of ditches take water above the station for irrigation, besides the water supply of Lyons and Longmont.[3]

The drainage area above this station is about 200 square miles.

The location and datum of the gage are probably the same as for the station used in 1903. On August 9, 1909, a new slope gage was put in, which is practically at the same datum as the old gage. The old bench mark could not be found.

The flow of the stream is affected by ice for several months during the winter.

These records were taken under the direction of the State engineer of Colorado and are published as furnished by him. They have not been verified by engineers of the United States Geological Survey.

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[1] For a full description of this basin see Hayden's report of 1875, p. 436. Also Report on agriculture by irrigation, Eleventh Census, by F. H. Newell, p. 103.

[2] This station is fully described in Water-Supply Paper U. S. Geol. Survey No. 99, p. 193.

[3] Idem, p. 195.

Discharge measurements of St. Vrain Creek at Lyons, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 2[a]	C. L. Chatfield	21	17	1.84	15
Mar. 21[a]	do	35	46	2.10	38
Mar. 22[b]	do	35	49	2.12	39
Mar. 23[c]	do	35	50	2.17	45
June 11[b]	Grieve and Hezmalhalch	39	81	3.10	230
June 28[b]	C. C. Hezmalhalch	36	66	2.75	145
Aug. 15[a]	do	39	57	2.33	70
Sept. 29[b]	C. L. Chatfield	38	51	2.18	49

[a] Made by wading. [b] Made from cable. [c] Made by wading under cable.

NOTE.—The channel was open when measurements were made in February and March.

Daily gage height, in feet, of St. Vrain Creek at Lyons, Colo., for 1910.

[Wm. Siglinger, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.9	1.8	1.75	2.0	2.6	3.4	3.2	2.65	2.15	2.1	1.9	1.7
2	1.9	1.75	1.65	2.0	2.5	3.5	3.0	2.7	2.15	2.1	1.95	1.75
3	1.9	1.75	1.65	2.0	2.4	3.65	2.95	2.55	2.25	2.1	1.95	1.8
4	1.9	1.85	1.8	2.05	2.55	3.45	2.95	2.55	2.45	2.1	1.85	1.8
5	1.9	1.75	1.85	2.1	2.65	3.4	2.95	2.55	2.55	2.0	1.9	1.7
6	1.85	1.75	1.9	2.25	2.5	3.3	2.85	2.45	2.5	1.95	1.9	1.65
7	1.9	1.75	1.85	2.2	2.4	3.4	2.8	2.45	2.4	2.0	1.9	1.65
8	1.9	1.75	1.9	2.15	2.45	3.25	2.75	2.45	2.4	2.0	1.9	1.7
9	1.85	1.75	1.85	2.0	2.5	3.15	2.7	2.45	2.4	1.9	1.85	1.9
10	1.85	1.7	1.7	2.0	2.75	3.05	2.7	2.35	2.3	1.95	1.85	1.9
11	1.8	1.8	1.7	2.1	2.85	3.05	2.7	2.3	2.3	1.95	1.8	1.85
12	1.85	1.75	1.8	2.05	2.9	3.05	2.65	2.3	2.3	1.9	1.85	1.9
13	1.9	1.75	1.85	2.1	2.85	3.1	2.7	2.35	2.3	1.9	1.85	1.85
14	1.9	1.75	1.85	2.05	2.85	3.1	2.7	2.4	2.4	1.9	1.85	1.65
15	1.9	1.65	2.0	2.05	2.8	3.1	2.6	2.3	2.35	1.95	1.85	1.7
16	1.9	1.8	2.0	2.0	2.7	3.1	2.6	2.25	2.3	1.95	1.8	1.8
17	1.95	1.8	2.0	2.0	2.65	3.2	2.6	2.25	2.3	2.05	1.75	1.9
18	1.9	1.8	2.0	1.95	2.6	3.05	2.6	2.35	2.35	2.00	1.8	1.8
19	1.9	1.8	2.0	1.95	2.6	3.1	2.65	2.35	2.4	2.05	1.85	1.85
20	1.9	1.7	2.05	2.0	2.65	3.1	2.95	2.35	2.4	2.1	1.75	1.85
21	1.85	1.7	2.05	2.05	2.8	3.1	2.9	2.35	2.45	2.0	1.7	1.85
22	1.9	1.8	2.15	2.0	2.65	3.0	2.75	2.4	2.4	2.05	1.85	1.8
23	1.9	1.8	2.1	1.95	2.8	3.0	2.65	2.4	2.4	2.1	1.8	1.8
24	1.9	1.85	2.1	2.0	2.8	2.95	2.55	2.35	2.3	2.0	1.85	1.85
25	1.85	1.85	2.1	2.05	2.85	2.9	2.55	2.3	2.25	2.0	1.8	1.9
26	1.8	1.8	2.1	2.15	2.9	2.95	2.55	2.25	2.25	2.0	1.8	1.8
27	1.85	1.85	2.1	2.3	2.9	2.75	2.5	2.2	2.2	2.0	1.75	1.75
28	1.8	1.85	2.1	2.4	3.1	2.75	2.6	2.25	2.15	1.85	1.7	1.8
29	1.8	.....	2.1	2.6	3.2	2.95	2.8	2.25	2.15	2.0	1.75	1.75
30	1.8	.....	1.95	2.65	3.3	3.00	2.95	2.2	2.1	1.95	1.85	1.75
31	1.8	.....	2.0	.....	3.3	.....	2.75	2.2	.....	1.9	.....	1.7

Daily discharge, in second-feet, of St. Vrain Creek at Lyons, Colo., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	18	13	12	26	114	318	258	124	42	36	18	11
2	18	12	10	26	96	353	202	134	42	36	22	12
3	18	12	10	26	80	406	190	105	56	36	22	13
4	18	16	13	31	105	336	190	105	88	36	16	13
5	18	12	16	36	124	318	190	105	105	26	18	11
6	16	12	18	56	96	288	166	88	96	22	18	10
7	18	12	16	48	80	318	154	88	80	26	18	10
8	18	12	18	42	88	273	144	88	80	26	18	11
9	16	12	16	26	96	244	134	88	80	18	16	18
10	16	11	11	26	144	216	134	72	64	22	16	18

Daily discharge, in second-feet, of St. Vrain Creek at Lyons, Colo., for 1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	13	13	11	36	166	216	134	64	64	22	13	16
12	16	12	13	31	178	216	124	64	64	18	16	18
13	18	12	16	36	166	230	134	72	64	18	16	16
14	18	12	16	31	166	230	134	80	80	18	16	10
15	18	10	26	31	154	230	114	64	72	22	16	11
16	18	13	26	26	134	230	114	56	64	22	13	13
17	22	13	26	26	124	258	114	56	64	31	12	18
18	18	13	26	22	114	216	114	72	72	26	13	13
19	18	13	26	22	114	230	124	72	80	31	16	16
20	18	11	31	26	124	230	190	72	80	36	12	16
21	16	11	31	31	154	230	178	72	88	26	11	16
22	18	13	42	26	124	202	144	80	80	31	16	13
23	18	13	36	22	154	202	124	80	80	36	16	13
24	18	16	36	26	154	190	105	72	64	26	16	16
25	16	16	36	31	166	178	105	64	56	26	13	18
26	13	13	36	42	178	190	105	56	56	26	13	13
27	16	16	36	64	178	144	96	48	48	26	12	12
28	13	16	36	80	230	144	114	56	42	16	11	13
29	13	.....	36	114	258	190	154	56	42	26	12	12
30	13	.....	22	124	288	202	190	48	36	22	16	12
31	13	.....	26	.....	288	.....	144	48	.....	18	.....	11

NOTE.—These discharges are based on one rating curve. These values are published as furnished by the State engineer of Colorado.

Monthly discharge of St. Vrain Creek at Lyons, Colo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January	22	13	16.7	1,030
February	16	10	12.9	716
March	42	10	23.5	1,440
April	124	22	39.7	2,360
May	288	80	150	9,220
June	406	144	241	14,300
July	258	96	146	8,980
August	134	48	75.8	4,660
September	105	36	67.6	4,020
October	36	16	26.0	1,600
November	22	11	15.0	893
December	18	10	13.6	836
The year	406	10	69.1	50,100

NOTE.—These estimates were computed by the United States Geological Survey from data furnished by the State engineer of Colorado, published herewith.

BOULDER CREEK AT ORODELL, COLO.

This station, which was established March 18, 1907, is located just above the mouth of Fourmile Creek, at Orodell, Colo., about 4 miles above Boulder, Colo. The records are valuable chiefly in connection with power development. Boulder Creek has an immense amount of fall, and the distance from the Continental Divide at its headwaters to the plains at Boulder is only 20 miles.

No diversions are made above the station. The first canal has its intake a short distance below.

The creek is frozen four or five months of the year and discharges for such periods have been estimated by interpolation between discharge measurements and weir records.

The records at this station since May 20, 1907, have been kept and furnished by the Central Colorado Power Co.

The data for 1910 are published as received and have not been verified by engineers of the United States Geological Survey.

Discharge measurements of Boulder Creek at Orodell, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 11[a]	C. L. Chatfield	7	4.51	0.30	7.36
Feb. 1[a]	do	7.5	4.4	.30	6.50
Feb. 21[a]	do	7.7	4.1	.25	6.10
Mar. 12[b]	Chatfield and Elliott	18.5	10.72	1.60	8.27
Apr. 21[c]	Thomas Grieve	34	29.1	2.25	65.4
June 13[c]	do	48	61.8	2.85	184
July 9[c]	do	34	46.0	2.50	113
July 16[c]	do	33.5	35.7	2.30	76.6
July 27[c]	C. C. Hezmalhalch	36.0	37.65	2.30	74.0
Aug. 13[c]	do	34	29.2	2.15	50.0
Sept. 13[c]	Thomas Grieve	28	18.3	1.93	26.1
Sept. 30[d]	C. L. Chatfield	27	19	1.89	25.6
Nov. 8[c]	Thomas Grieve	23.5	12.6	1.68	4.7
Nov. 30[c]	do	15	4.7	1.30	2.4

[a] Measurement made at temporary station at power house.
[b] Made at Orodell.
[c] Made by wading.
[d] Made from cable.

Daily gage height, in feet, of Boulder Creek at Orodell, Colo., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Nov.	Nov.	Dec.
1	0.36	0.28	0.28	1.9	2.4	3.15	2.8	2.35	2.0	1.75	1.7	1.4
2	.30	.28	.25	1.9	2.35	3.2	2.9	2.35	1.9	1.75	1.6	1.45
3	.28	.34	.35	2.0	1.85	3.25	.....	2.35	1.9	1.75	1.6	1.6
4	.31	.34	.38	1.9	2.15	3.2	.....	2.35	1.9	1.75	1.65	1.5
5	.38	.29	.38	1.9	2.25	3.15	.....	2.5	2.05	1.75	1.6	1.6
6	.36	.30	.37	1.95	2.2	3.05	.....	2.45	2.05	1.75	1.6	1.55
7	.30	.30	1.65	1.95	2.3	3.05	.....	2.45	2.05	1.75	1.5	1.45
8	.30	.29	1.65	1.8	2.55	3.0	.....	2.35	2.05	1.75	1.7	1.45
9	.30	.28	1.70	1.55	2.55	2.85	2.5	2.35	2.1	1.8	1.75	1.45
10	.29	.29	1.60	1.55	2.7	2.85	2.45	2.25	2.05	1.75	1.6	1.55
11	.31	.29	1.60	1.65	2.85	2.8	2.45	2.2	1.95	1.7	1.6	1.55
12	.39	.28	1.60	1.8	2.85	2.8	2.45	2.25	1.95	1.7	1.65	1.55
13	.36	.29	1.65	1.8	2.8	2.8	2.45	2.2	1.95	1.7	1.65	1.5
14	.30	.29	1.65	2.15	2.8	2.8	2.35	2.2	2.0	1.7	1.45	1.65
15	.30	.32	1.65	2.15	2.75	2.75	2.25	2.15	2.0	1.6	1.5	1.65
16	.30	[a].80	1.70	2.15	.....	2.75	2.25	2.15	2.0	1.65	1.55	1.65
17	.30	.65	1.70	2.1	.....	2.7	2.3	2.15	2.0	1.75	1.45	1.6
18	.29	.60	1.75	1.95	.....	2.7	2.35	2.1	2.0	1.9	1.5	.....
19	.28	.29	1.80	2.0	.....	2.7	2.5	2.1	1.9	1.65	1.5	.....
20	.28	.28	1.90	2.05	.....	2.7	2.5	2.15	1.9	1.6	1.5	.....
21	.24	.25	1.95	2.25	1.95	2.7	2.4	2.1	1.85	1.7	1.55	.....
22	.25	.24	2.00	2.15	1.95	2.7	2.4	2.05	1.9	1.75	1.6	.....
23	.25	.25	2.10	2.05	1.95	2.7	2.5	2.25	1.9	1.75	1.6	.....
24	.34	.25	2.05	2.1	1.9	2.7	2.4	2.2	1.8	1.75	1.65	.....
25	.35	.26	2.05	2.25	2.05	2.7	2.35	2.15	1.8	1.8	1.6	.....
26	.85	.28	2.00	2.05	2.15	2.7	2.35	2.05	1.75	1.8	1.5	.....
27	.58	.26	1.90	2.35	2.5	2.7	2.3	2.0	1.8	1.75	1.5	.....
28	.55	.28	1.90	2.25	2.75	2.65	2.4	1.9	1.8	1.75	1.45	.....
29	.40	.....	1.90	2.5	3.0	2.65	2.4	1.9	1.8	1.7	1.4	.....
30	.29	.....	1.75	2.65	3.1	2.75	2.4	1.9	1.8	1.7	1.4	.....
31	.28	.....	1.90	.....	3.15	.....	2.35	2.0	.....	1.75	.....	.....

[a] Probably caused by choking of channel below.

NOTE.—Ice, Jan. 1 to Mar. 7, and Dec. 18 to 31.

Daily discharge, in second-feet, of Boulder Creek at Orodell, Colo., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	24	92	254	174	83	33	16	13	4
2	.....	24	83	266	196	83	24	16	9	5
3	.....	33	21	278	152	83	24	16	9	9
4	.....	24	51	266	152	83	24	16	11	6
5	.....	24	66	254	142	112	38	16	9	9
6	.....	28	58	230	132	102	38	16	9	8
7	.....	28	74	230	112	102	38	16	6	5
8	11	18	122	218	112	83	38	16	13	5
9	13	8	122	185	112	83	44	18	16	5
10	9	8	152	185	102	66	38	16	9	8
11	9	11	185	174	102	58	28	13	9	8
12	9	18	185	174	102	66	28	13	11	8
13	11	18	174	174	102	58	28	13	11	6
14	11	51	174	174	83	58	33	13	5	11
15	11	51	163	163	66	51	33	9	6	11
16	13	51	174	163	66	51	33	11	8	11
17	13	44	122	152	74	51	33	16	5	9
18	16	28	51	152	83	44	33	24	6	.....
19	18	33	40	152	112	44	24	11	6	.....
20	24	38	28	152	112	51	24	9	6	.....
21	28	66	28	152	92	44	21	13	8	.....
22	33	51	28	152	92	38	24	16	9	.....
23	44	38	28	152	112	66	24	16	9	.....
24	38	44	24	152	92	58	18	16	11	.....
25	38	66	38	152	83	51	18	18	9	.....
26	33	38	51	152	83	38	16	18	6	.....
27	24	83	112	152	74	33	18	16	6	.....
28	24	66	163	142	92	24	18	16	5	.....
29	24	112	218	142	92	24	18	13	4	.....
30	16	142	242	163	92	24	18	13	4	.....
31	24	.....	254	.....	83	33	.....	16	.....	.....

NOTE.—These discharges are based on one rating curve. They are published as computed by the Central Colorado Power Co. Discharges estimated May 16 to 20 and July 3 to 8.

Monthly discharge of Boulder Creek at Orodell, Colo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January	.....	.....	[a] 7.3	449
February	.....	.....	[a] 6.5	361
March	44	.....	[a] 18.0	1,110
April	142	8	42.3	2,520
May	254	21	107	6,580
June	278	142	184	10,900
July	196	66	106	6,520
August	112	24	59.5	3,660
September	44	16	27.6	1,640
October	24	9	15.0	922
November	16	4	8.3	494
December	11	.....	[a] 7.3	449
The year	278	.....	49.2	35,600

[a] Discharges estimated Jan. 1 to Mar. 7 and Dec. 18 to 31 by the State engineer of Colorado because of ice conditions.

NOTE.—These estimates have been computed by the United States Geological Survey from data furnished by the Central Colorado Power Co., published herewith.

SOUTH BOULDER CREEK NEAR ROLLINSVILLE, COLO.

This station was established September 10, 1910, by the United States Geological Survey, in cooperation with the United States Forest Service, and is being maintained as a cooperative station.

It is located at highway bridge about 1¼ miles above Rollinsville, and about 3 miles below the mouth of Jenny Creek.

A vertical rod gage, graduated to feet and tenths, is fastened to the right crib abutment of bridge.

Low-water measurements are made by wading; high-water measurements can be made from the highway bridge.

The channel is composed mainly of bowlders and is fairly permanent, but is so rough that the measuring section is poor.

Gage heights are affected by ice during the winter months.

Discharge measurements of South Boulder Creek near Rollinsville, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Sept. 10	W. B. Freeman	14	8.7	0.9	9.4
Sept. 24	S. T. Harding	21	8.9	.87	6.3

NOTE.—These measurements made by wading above the gage.

The following additional gage heights, in feet, were observed by F. D. Whitney:

Date.	Gage height.	Date.	Gage height.	Date.	Gage height.	Date.	Gage height.
Sept. 11	0.9	Sept. 18	0.9	Sept. 23	0.9	Oct. 3	0.8
Sept. 12	.95	Sept. 20	.9	Sept. 25	.8	Oct. 4	.85
Sept. 13	.95	Sept. 21	.95	Oct. 1	.8	Oct. 5	.9
Sept. 14	.95	Sept. 22	.9	Oct. 2	.8	Oct. 6	.9
Sept. 15	.95						

SOUTH BOULDER CREEK NEAR MARSHALL, COLO.

This station, which is located at the mouth of the canyon about 3 miles west of the Colorado & Southern Railway station at Marshall, was maintained under the direction of the United States Geological Survey from 1895 to 1901[1] and since then more or less intermittent records have been obtained under the direction of the State engineer of Colorado.

Two ditches, the more important being the Community ditch, divert water above the station.

The rod gage, which has the same datum as in 1901, is located a short distance below the Community canal.

The drainage area above this station is about 195 square miles.

[1] See Water-Supply Paper U. S. Geol. Survey No. 49, 1901, p. 287.

During 1909 the station was maintained both by the State engineer and by the Denver Reservoir & Irrigation Co., and they have used the same daily gage readings. The daily discharges have been computed from discharge measurements made by both parties and they have both agreed upon them. The Denver Reservoir & Irrigation Co. also obtained records of the flow of the Community ditch.

Ice prevails at this station for several months during the winter.

During 1910 this station was maintained by the State engineer of Colorado. The data are published as furnished by him. They have not been verified by engineers of the United States Geological Survey.

Discharge measurements of South Boulder Creek near Marshall, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 13	C. C. Hezmalhalch	38	39.8	1.95	121
July 27	do	28	12.6	1.30	23.1
Aug. 14	do	24.5	17.4	1.40	33
Sept. 30	C. L. Chatfield	21.5	13.0	1.05	8.6
Feb. 1	do	21	9.24	1.10	10.4

NOTE.—All measurements were made by wading at various sections.

Daily gage height, in feet, of South Boulder Creek near Marshall, Colo., for 1910.

[B. E. Chesebro, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.15	1.1	1.1	1.3	1.8	2.2	1.7	1.5	1.1	1.05	1.1	1.0
2	1.2	1.1	1.1	1.3	1.75	2.2	1.7	1.5	1.1	1.05	1.1	1.0
3	1.2	1.1	1.1	1.3	1.75	2.25	1.7	1.4	1.1	1.05	1.1	1.05
4	1.15	1.1	1.1	1.25	1.75	2.2	1.7	1.5	1.1	1.0	1.1	1.1
5	1.1	1.05	1.1	1.25	1.8	2.1	1.65	1.45	1.2	1.1	1.05	.9
6	1.05	1.05	1.1	1.25	1.7	2.1	1.6	1.4	1.15	1.1	1.1	.9
7	1.0	1.05	1.1	1.3	1.7	2.1	1.6	1.35	1.1	1.1	1.1	.9
8	.95	1.0	1.2	1.25	1.7	2.1	1.55	1.35	1.1	1.1	1.1	1.0
9	.9	1.0	1.25	1.25	1.8	2.0	1.5	1.35	1.1	1.1	1.05	1.15
10	.9	1.0	1.15	1.3	1.9	2.0	1.55	1.35	1.1	1.1	1.1	1.15
11	.9	1.0	1.15	1.3	1.9	1.95	1.5	1.3	1.1	1.05	1.05	1.1
12	.95	1.0	1.1	1.3	2.0	2.0	1.5	1.25	1.1	1.05	1.1	1.15
13	.95	1.0	1.15	1.35	1.9	2.0	1.45	1.4	1.1	1.05	1.1	1.1
14	.9	1.1	1.2	1.25	1.95	2.0	1.45	1.4	1.2	1.05	1.05	.9
15	.95	1.0	1.25	1.25	1.9	1.95	1.4	1.3	1.1	1.1	1.1	1.0
16	1.0	1.0	1.25	1.15	1.9	1.9	1.4	1.3	1.1	1.1	1.1	1.05
17	1.0	1.0	1.25	1.15	1.9	1.9	1.6	1.3	1.1	1.1	1.1	1.05
18	1.05	1.0	1.25	1.2	1.9	1.9	1.6	1.3	1.2	1.1	1.1	1.0
19	1.1	1.0	1.3	1.3	1.8	1.85	1.6	1.25	1.2	1.2	1.05	1.0
20	1.1	1.0	1.3	1.4	1.8	1.8	1.55	1.25	1.1	1.15	1.0	1.0
21	1.1	1.05	1.4	1.6	1.9	1.8	1.5	1.2	1.1	1.1	.9	1.05
22	1.1	1.05	1.45	1.5	1.9	1.8	1.5	1.2	1.1	1.15	1.1	1.0
23	1.1	1.0	1.5	1.4	2.0	1.8	1.45	1.2	1.2	1.2	1.1	1.0
24	1.1	1.05	1.35	1.4	1.9	1.8	1.4	1.2	1.1	1.15	1.15	1.05
25	1.1	1.1	1.5	1.5	1.9	1.85	1.35	1.15	1.1	1.15	1.1	1.05
26	1.1	1.1	1.4	1.6	1.9	1.8	1.3	1.15	1.1	1.15	1.05	1.05
27	1.1	1.1	1.4	1.7	1.9	1.8	1.3	1.1	1.1	1.15	1.05	1.0
28	1.1	1.1	1.3	1.8	2.0	1.75	1.5	1.1	1.1	.95	.95	1.0
29	1.1	.....	1.15	1.8	2.05	1.8	1.6	1.1	1.05	1.15	.95	.95
30	1.1	.....	1.3	1.85	2.15	1.8	1.8	1.1	1.05	1.05	.95	.95
31	1.1	.....	1.3	.....	2.2	.....	1.6	1.1	.....	1.1	.....	.9

Daily discharge, in second-feet, of South Boulder Creek near Marshall, Colo., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	14	11	11	24	88	173	72	43	11	8	11	6
2	17	11	11	24	80	173	72	43	11	8	11	6
3	17	11	11	24	80	188	72	33	11	8	11	8
4	14	11	11	20	80	173	72	43	11	6	11	11
5	11	8	11	20	88	148	64	38	17	11	8	3
6	8	8	11	20	72	148	57	33	14	11	11	3
7	6	8	11	24	72	148	57	28	11	11	11	3
8	4	6	17	20	72	148	50	28	11	11	11	6
9	3	6	20	20	88	126	43	28	11	11	8	14
10	3	6	14	24	106	126	50	28	11	11	11	14
11	3	6	14	24	106	116	43	24	11	8	8	11
12	4	6	11	24	126	126	43	20	11	8	11	14
13	4	6	14	28	106	126	38	33	11	8	11	11
14	3	11	17	20	116	126	38	33	17	8	8	3
15	4	6	20	20	106	116	33	24	11	11	11	6
16	6	6	20	14	106	106	33	24	11	11	11	8
17	6	6	20	14	106	106	57	24	11	11	11	8
18	8	6	20	17	106	106	57	24	17	11	11	6
19	11	6	24	24	88	97	57	20	17	17	8	6
20	11	6	24	33	88	88	50	20	11	14	6	6
21	11	8	33	57	106	88	43	17	11	11	3	8
22	11	8	38	43	106	88	43	17	11	14	11	6
23	11	6	43	33	126	88	38	17	17	17	11	6
24	11	8	28	33	106	88	33	17	11	14	14	8
25	11	11	43	43	106	97	28	14	11	14	11	8
26	11	11	33	57	106	88	24	14	11	14	8	8
27	11	11	33	72	106	88	24	11	11	14	8	6
28	11	11	24	88	126	80	43	11	11	4	4	6
29	11	.....	14	88	137	88	57	11	8	14	4	4
30	11	.....	24	97	160	88	88	11	8	8	4	4
31	11	.....	24	.....	173	.....	57	11	.....	11	.....	3

NOTE.—These discharges are based on one rating curve. They are published as computed by the State engineer of Colorado.

Monthly discharge of South Boulder Creek near Marshall, Colo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January	17	3	9.0	553
February	11	6	8.0	444
March	43	11	20.9	1,290
April	97	14	35.0	2,080
May	173	72	104	6,400
June	188	88	118	7,020
July	88	24	49.5	3,040
August	43	11	23.9	1,470
September	17	8	11.9	708
October	17	6	11.4	701
November	14	3	9.3	553
December	14	3	7.1	437
The year	188	3	34.2	24,700

NOTE.—These estimates were computed by the United States Geological Survey from data furnished by the State engineer of Colorado, published herewith.

BIG THOMPSON CREEK BASIN.

DESCRIPTION.

Big Thompson Creek drains the country lying between St. Vrain Creek and Cache la Poudre River. It is one of the largest tributaries of the South Platte, into which it discharges about 4 miles above

the town of Evans. It is joined by Little Thompson Creek a short distance above the point where their combined waters enter the South Platte.

Nearly all the normal flow of Big and Little Thompson creeks is used for irrigation.

BIG THOMPSON CREEK AT ARKINS, COLO.

This station is located at a private wagon bridge 10 or 12 miles above Loveland, and about 400 feet below the Handy dam. Measurements of flow of Big Thompson Creek have been made at or near Arkins since 1888, the earlier records being kept by the State engineer. From 1895 to 1903 the station was maintained under the direction of the United States Geological Survey. Since that time it has been continued more or less intermittently under the direction of the State engineer, by whom all records are furnished.

A rod gage on the bridge pier was established in 1909 at a different datum from the 1903 gage, as the old bench mark could not be found. The Handy ditch diverts water for irrigation above the station. In 1903 this ditch used 17,000 acre-feet of water.

The flow of the creek is affected by ice for several months during the winter season.

Discharge measurements of Big Thompson Creek at Arkins, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 4[a]	C. L. Chatfield	42	31	1.42	21
Mar. 17[b]	do	42.5	49	1.10	[c] 27
Apr. 20[b]	Thomas Grieve	36.5	38	1.10	34
June 10[d]	C. C. Hezmalhalch	57.5	124	2.20	310
June 25[d]	do	57.5	111	2.00	265
Aug. 16[b]	do	80	72	1.40	86
Sept. 27[b]	C. L. Chatfield	61	75	1.30	64
Dec. 5[e]	C. C. Hezmalhalch		22.8	.86	6.0

[a] Measurement made through holes cut in ice.
[b] Wading measurement.
[c] No ice.
[d] Made from bridge.
[e] Ice.

Daily gage height, in feet, of Big Thompson Creek at Arkins, Colo., for 1910.

[Miss Minnie Gammon, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.6	1.5	1.15	1.1	1.7	2.75	2.25	1.9	1.3	1.3	0.85	1.15
2	1.65	1.5	1.1	1.0	1.6	2.85	2.1	1.8	1.25	1.3	1.15	1.2
3	1.6	1.3	1.1	.95	1.5	2.9	2.0	1.7	1.25	1.3	1.1	1.1
4	1.55	1.25	1.1	.95	1.65	2.85	2.0	1.5	1.7	1.25	1.1	1.1
5	1.4	1.3	1.1	1.0	1.8	2.55	2.05	1.55	1.85	1.2	1.1	.95
6	1.35	1.25	1.1	1.0	1.65	2.6	2.1	1.5	1.6	1.2	1.1	.85
7	1.3	1.4	1.15	1.0	1.55	2.65	1.9	1.4	1.55	1.2	1.1	1.0
8	1.35	1.45	1.15	1.05	1.5	2.6	2.0	1.35	1.5	1.2	1.15	1.1
9	1.4	1.5	1.15	1.05	1.7	2.3	2.0	1.3	1.45	1.2	1.15	1.2
10	1.35	1.5	1.15	1.1	1.9	2.15	1.75	1.3	1.4	1.2	1.15	1.2

Daily gage height, in feet, of Big Thompson Creek at Arkins, Colo., for 1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	1.35	1.5	1.1	1.1	2.1	2.2	1.7	1.3	1.35	1.15	1.1	1.2
12	1.35	1.5	1.1	1.15	2.15	2.45	1.6	1.4	1.5	1.15	1.1	1.15
13	1.3	1.4	1.1	1.2	2.1	2.4	1.7	1.5	1.55	1.15	1.1	1.05
14	1.2	1.4	1.1	1.15	2.05	2.5	1.7	1.6	1.55	1.2	1.1	1.1
15	1.35	1.3	1.1	1.1	2.0	2.4	1.7	1.5	1.55	1.2	1.1	1.15
16	1.4	1.3	1.1	1.1	1.9	2.45	1.65	1.4	1.5	1.2	1.1	1.1
17	1.3	1.4	1.1	1.2	1.8	2.4	1.8	1.4	1.6	1.25	1.05	1.1
18	1.3	1.4	1.1	1.1	1.7	2.3	1.8	1.35	1.6	1.25	1.05	1.0
19	1.3	1.4	1.1	1.1	1.75	2.4	1.8	1.3	1.65	1.2	1.05	.95
20	1.3	1.4	1.1	1.15	1.85	2.35	1.9	1.3	1.7	1.25	.95	1.05
21	1.4	1.45	1.2	1.25	2.0	2.2	1.9	1.3	1.7	1.2	1.0	.95
22	1.4	1.45	1.2	1.25	1.9	2.2	1.8	1.4	1.7	1.25	1.1	1.05
23	1.4	1.45	1.2	1.2	1.9	2.2	1.7	1.45	1.7	1.2	1.1	1.1
24	1.4	1.5	1.3	1.2	1.9	2.2	1.6	1.45	1.5	1.2	1.1	1.1
25	1.4	1.5	1.3	1.3	2.0	2.15	1.5	1.4	1.45	1.2	1.05	1.15
26	1.35	1.45	1.3	1.4	2.0	2.0	1.5	1.3	1.45	1.15	1.0	1.05
27	1.45	1.4	1.2	1.55	2.0	2.0	1.6	1.2	1.4	1.05	.95	1.0
28	1.5	1.35	1.2	1.65	2.2	2.0	2.0	1.2	1.4	.9	1.0	.9
29	1.5	.....	1.2	1.8	2.55	2.25	2.3	1.3	1.3	.9	1.1	.8
30	1.5	.....	1.05	1.8	2.75	2.5	2.45	1.3	1.3	.9	1.05	.8
31	1.5	.....	1.2	.....	2.8	.....	2.25	1.3	.....	.9	.....	.8

NOTE.—Ice from January 1 to about February 28.

Daily discharge, in second-feet, of Big Thompson Creek at Arkins, Colo., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	39	30	162	517	338	222	66	66	5	39
2	.....	.....	30	17	135	555	288	192	57	66	39	48
3	.....	.....	30	12	110	574	255	162	57	66	30	30
4	.....	.....	30	12	148	555	255	110	162	57	30	30
5	.....	.....	30	17	192	442	272	122	207	48	30	12
6	.....	.....	30	17	148	460	288	110	135	48	30	6
7	.....	.....	39	17	122	479	222	86	122	48	30	17
8	.....	.....	39	24	110	460	255	76	110	48	39	30
9	.....	.....	39	24	162	355	255	66	98	48	39	48
10	.....	.....	39	30	222	304	177	66	86	48	39	48
11	.....	.....	30	30	288	320	162	66	76	39	30	48
12	.....	.....	30	39	304	408	135	86	110	39	30	39
13	.....	.....	30	48	288	390	162	110	122	39	30	24
14	.....	.....	30	39	272	425	162	135	122	48	30	30
15	.....	.....	30	30	255	390	162	110	122	48	30	39
16	.....	.....	30	30	222	408	148	86	110	48	30	30
17	.....	.....	30	48	192	390	192	86	135	57	24	30
18	.....	.....	30	30	162	355	192	76	135	57	24	17
19	.....	.....	30	30	177	390	192	66	148	48	24	12
20	.....	.....	30	39	207	372	222	66	162	57	12	24
21	.....	.....	48	57	255	320	222	66	162	48	17	12
22	.....	.....	48	57	222	320	192	86	162	57	30	24
23	.....	.....	48	48	222	320	162	98	162	48	30	30
24	.....	.....	66	48	222	320	135	98	110	48	30	30
25	.....	.....	66	66	255	304	110	86	98	48	24	39
26	.....	.....	66	86	255	255	110	66	98	39	17	24
27	.....	.....	48	122	255	255	135	48	86	24	12	17
28	.....	.....	48	148	320	255	255	48	86	8	17	8
29	.....	.....	48	192	442	338	355	66	66	8	30	5
30	.....	.....	24	192	517	425	408	66	66	8	24	5
31	.....	.....	48	.....	536	.....	338	66	.....	8	.....	5

NOTE.—These discharges are based on one rating curve. They are published as computed by the State engineer of Colorado.

Monthly discharge of Big Thompson Creek at Arkins, Colo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
January	.....	.....	[a] 28.7	1,760
February	.....	.....	[a] 25.9	1,440
March	66	24	38.8	2,390
April	192	12	52.6	3,130
May	536	110	238	14,600
June	574	255	389	23,100
July	408	110	218	13,400
August	222	48	93.3	5,740
September	207	57	115	6,840
October	66	8	44.1	2,710
November	39	5	26.9	1,600
December	48	5	25.8	1,590
The year	574	.....	108	78,300

[a] Discharge Jan. 1 to Feb. 28 estimated by the State Engineer of Colorado.

NOTE.—These estimates have been computed by the United States Geological Survey from data furnished by the State engineer of Colorado, published herewith.

CACHE LA POUDRE RIVER BASIN.

DESCRIPTION.

Cache la Poudre River is the largest and the northernmost of the tributaries discharging from the east front of the Rocky Mountains into the South Platte. During the irrigation season its discharge is augmented by the supply diverted from the headwaters of Laramie River, which heads immediately west of the headwaters of the Cache la Poudre, the diversion being made through a canal known as the Sky Line canal. Measurements of the discharge of the Cache la Poudre basin therefore include some of the Laramie waters. As is the case with other streams of this region, the normal flow is almost entirely consumed for irrigation, and even the greater part of the flood waters is stored for late use. The earliest and most thorough irrigation of the State is carried on along this stream.[1]

CACHE LA POUDRE RIVER NEAR ELKHORN, COLO.

This station, which was established January 6, 1909, to determine the amount of water available for storage and power development, is located at the lower bridge at Fry's ranch, on the stage line, 50 miles above Fort Collins, 7 miles above Elkhorn post office, and 20 miles below Chambers Lake.

Sheep Gulch comes in about a mile above the station and Elkhorn Creek enters about 8 miles below. The drainage area is about 250 square miles, at elevations from 7,500 to 11,500 feet.

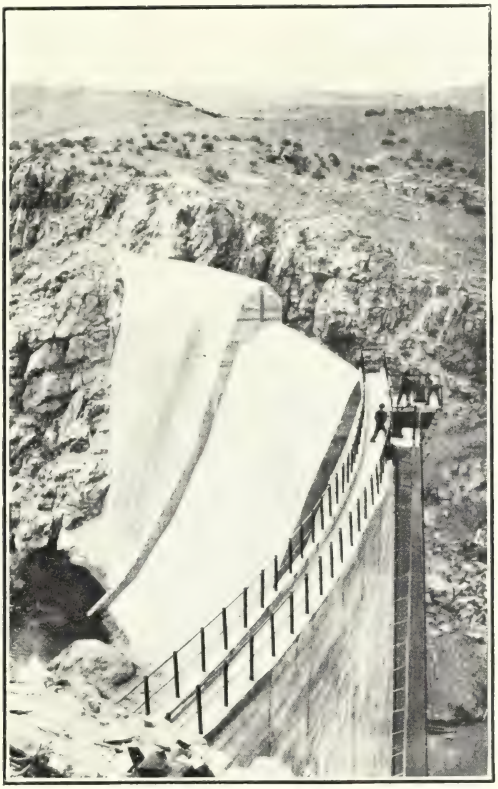
No water is diverted for irrigation above the station, but the North Grand ditch has been diverting water from the North Fork of Grand River into the Cache la Poudre, above the station, for a number of

[1] See Water-Supply Paper U. S. Geol. Survey No. 9, and Dept. of Agr. Office of Experiment Stations, Bull. No. 92.

A. ICE ON CACHE LA POUDRE RIVER NEAR HOME, COLO.

B. GAGING STATION ON CACHE LA POUDRE RIVER AT FRY'S RANCH, NEAR ELKHORN, COLO.

Showing method of making discharge measurement under ice.



A. HALLIGAN DAM, 72 FEET HIGH, ON NORTH FORK OF CACHE LA POUDRE RIVER NEAR LIVERMORE, COLO.

Looking across dam; spillway about 10 feet below crest.

B. BRISTOL AUTOMATIC GAGE USED AT GAGING STATION ON LARAMIE RIVER AT GLENDEVEY, COLO.

years, and the Chambers Lake reservoir has been used to regulate the flow for irrigation below. The proposed Roosevelt reservoir, which is to be used in connection with a power project, is located about 3 miles above the station and will have a capacity of 117,000 acre-feet, with a dam 231 feet high above the stream bed.

Discharge measurements at high and medium stages are made from the highway bridge, upon which the chain gage is located. Winter measurements are made through the ice. (See Pl. III.)

The stream flow is affected by ice for several months each winter.

During 1909 and 1910 frequent measurements were made by parties cooperating with the United States Geological Survey through George B. McFadden, an engineer of Denver, Colo. Computations of daily and monthly discharges have been made by engineers of the United States Geological Survey.

In developing rating curves for this station for 1909 the discharge measurements were considered in groups as the channel conditions are permanent, though rough. Owing to the erratic plotting of high-water measurements, the estimates for this period should be used with caution. For 1910 individual measurements were plotted, properly weighted, and rating curves developed.

A peculiarity has been noted in the rating for this station for 1909 and 1910. Above gage height 5.0 feet the measurements show that a second curve, parallel to the main curve and giving smaller discharges for the same gage heights, should be used for certain periods. This temporary change in the rating may be due to obstructions on the control below the gage or to insufficient channel capacity.

Discharge measurements of Cache la Poudre River near Elkhorn, Colo., in 1901.[a]

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 1...	20	51	3.10	43	Feb. 7...	20	40	2.50	27
2...	20	43	2.74	32	8...	20	40	2.54	26
3...	20	43	2.74	34	9...	20	42	2.62	25
12...	20	45	2.77	26	10...	20	46	2.78	23
13...	20	61	3.58	32	11...	20	44	2.66	22
14...	20	51	3.14	32	13...	20	42	2.60	27
15...	20	41	2.60	30	14...	20	40	2.50	22
16...	20	39	2.54	33	19...	20	40	2.48	29
17...	20	39	2.53	30	22...	20	40	2.47	14
18...	20	43	2.68	25	23...	20	40	2.53	21
19...	20	39	2.54	24	24...	20	42	2.64	23
20...	20	37	2.43	21	25...	20	44	2.68	24
21...	20	39	2.51	23	26...	20	44	2.69	26
22...	20	37	2.43	24	27...	20	46	2.80	27
23...	20	39	2.47	29	28...	20	40	2.53	21
24...	20	39	2.53	31	Mar. 1...	20	46	2.79	24
25...	20	39	2.50	30	2...	20	44	2.74	26
26...	20	37	2.41	20	3...	20	48	2.86	30
28...	20	39	2.48	25	4...	20	44	2.60	32
29...	20	39	2.50	30	5...	20	44	2.70	49
30...	20	45	2.81	23	6...	20	38	2.40	30
31...	20	41	2.63	25	7...	20	44	2.71	54
Feb. 1...	20	41	2.63	28	8...	20	44	2.74	59
3...	20	41	2.64	30	9...	20	42	2.62	45
4...	20	44	2.70	29	10...	20	36	2.29	24
5...	20	42	2.60	29	11...	20	42	2.58	48
6...	20	40	2.52	26	12...	20	34	2.22	21

[a] Measurements Jan. 1 to 24 by H. Mertens; Jan. 25 to Oct. 31 by N. W. Fry; Nov. 1 to 12 by H. Mertens (second measurement on Nov. 4 and first measurement on Nov. 5 made by W. B. Freeman); Nov. 13 to Dec. 31 by N. W. Fry. Ice Jan. 1 to Mar. 10 and Dec. 6 to 31.

Discharge measurements of Cache la Poudre River near Elkhorn, Colo., in 1901—Contd.

Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 13	20	36	2.33	25
14	20	38	2.41	32
15	20	38	2.41	34
16	20	38	2.37	32
17	24	44	2.50	41
18	24	43	2.49	39
19	24	43	2.50	40
20	35	54	2.48	39
21	35	54	2.48	41
22	35	54	2.51	45
23	35	58	2.59	56
24	35	54	2.52	48
25	35	54	2.52	44
26	35	58	2.60	57
27	35	54	2.54	44
28	35	54	2.52	40
30	35	59	2.60	50
31	35	66	2.84	82
Apr. 1	35	58	2.58	46
2	35	54	2.50	41
3	35	54	2.54	44
4	35	54	2.54	44
5	35	58	2.61	50
6	35	54	2.48	39
7	35	54	2.53	45
8	35	58	2.57	47
9	35	58	2.64	51
10	35	61	2.74	62
11	35	65	2.79	73
12	35	65	2.82	76
13	35	65	2.81	74
14	35	65	2.81	77
15	35	61	2.73	61
16	35	65	2.78	73
17	35	58	2.63	53
18	35	66	2.76	70
19	35	68	2.87	82
20	39.6	78	3.07	113
21	39.6	93	3.34	155
22	39.6	77	3.13	117
23	39.6	77	3.08	116
24	39.6	85	3.30	154
25	39.6	109	3.56	176
26	39.6	110	3.60	191
27	39.6	117	3.83	264
28	39.6	131	4.18	366
29	39.6	147	4.56	492
30	39.6	153	4.48	454
May 3	39.6	115	3.80	287
4	39.6	119	3.90	303
5	39.6	135	4.26	428
6	39.6	127	4.08	353
7	39.6	125	3.96	326
8	39.6	120	3.89	291
9	39.6	139	4.38	443
10	39.6	158	4.90	616
11	39.6	162	4.98	716
12	39.6	167	5.10	807
13	39.6	166	5.06	754
14	39.6	162	4.98	684
15	39.6	144	5.02	669
16	39.6	143	4.50	518
17	39.6	135	4.32	421
18	39.6	140	4.42	472
19	39.6	139	4.44	529
20	39.6	147	4.58	582
21	39.6	143	4.50	570
22	39.6	140	4.39	437
23	39.6	140	4.44	496
24	39.6	150	4.66	591
25	39.6	154	4.82	607
26	39.6	158	4.90	632
27	39.6	158	4.94	623
28	39.6	170	5.56	1,004
29	39.6	198	5.88	1,237
30	39.6	206	6.08	1,531
31	39.6	198	5.94	1,439
June 1	39.6	202	5.99	1,480
2	39.6	201	6.20	1,593
June 4	39.6	206	6.15	1,461
5	39.6	206	6.00	1,210
6	39.6	195	5.71	1,085
7	39.6	191	5.60	1,021
8	39.6	188	5.54	956
9	39.6	187	5.50	885
10	39.6	177	5.28	832
11	39.6	175	5.22	819
12	39.6	170	5.28	856
13	39.6	177	5.27	838
14	39.6	183	5.45	918
15	39.6	179	5.29	922
16	39.6	175	5.20	837
17	39.6	175	5.22	812
18	39.6	172	5.12	751
19	39.6	179	4.98	668
20	39.6	167	5.02	668
21	39.6	168	4.99	655
22	39.6	160	4.77	595
23	39.6	158	4.76	588
24	39.6	152	4.56	561
25	39.6	144	4.43	455
26	39.6	149	4.48	517
27	39.6	144	4.43	448
28	39.6	144	4.40	452
29	39.6	149	4.52	532
30	39.6	152	4.61	586
July 1	39.6	148	4.48	502
2	39.6	144	4.37	455
3	39.6	141	4.26	393
4	39.6	138	4.25	400
5	39.6	144	4.38	464
6	39.6	136	4.16	354
7	39.6	131	4.06	323
8	39.6	129	4.00	301
9	39.6	124	3.94	288
10	39.6	124	3.92	280
11	39.6	120	3.83	261
12	39.6	120	3.76	242
13	39.6	116	3.69	228
14	39.6	116	3.67	225
15	39.6	112	3.60	203
16	39.6	112	3.60	195
17	39.6	112	3.63	214
18	39.6	120	3.82	246
19	39.6	116	3.69	229
20	39.6	120	3.77	254
21	39.6	116	3.71	235
22	39.6	112	3.64	206
23	39.6	112	3.56	202
24	39.6	108	3.47	181
25	39.6	104	3.37	162
26	39.6	100	3.30	144
27	39.6	96	3.24	134
28	39.6	116	3.68	226
30	39.6	132	4.12	336
31	39 6	116	3.66	215
Aug. 1	39.6	108	3.53	187
2	39.6	104	3.43	160
3	39.6	98	3.35	142
4	39.6	95	3.24	132
5	39.6	99	3.28	144
6	39.6	95	3.22	136
7	39.6	94	3.12	113
8	39.6	85	3.06	108
9	38	79	3.02	101
10	38	65	3.00	99
11	38	85	2.98	98
12	38	85	3.04	98
13	39.6	99	3.16	118
14	39.6	89	3.19	130
15	39.6	89	3.16	125
16	38	85	3.02	103
17	38	82	2.93	88
18	38	81	2.92	86
19	38	81	2.90	88
20	38	81	2.86	80
21	38	81	2.91	87
22	38	81	2.92	88

Discharge measurements of Cache la Poudre River near Elkhorn, Colo., 1901—Contd.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 23	38	81	2.89	85	Oct. 25	38	73	2.72	57
24	38	77	2.84	74	26	38	77	2.77	60
25	38	77	2.81	72	27	38	73	2.74	60
26	38	74	2.74	62	28	38	73	2.66	52
27	38	81	2.90	83	29	38	73	2.71	61
28	38	89	3.10	108	30	38	72	2.64	52
29	38	85	2.97	93	31	38	73	2.68	55
30	38	81	2.90	85	Nov. 1	38	73	2.72	58
31	38	77	2.81	72	2	38	73	2.68	55
Sept. 1	38	77	2.82	71	3	38	72	2.66	50
2	38	73	2.74	63	4	38	76	2.80	65
3	38	77	2.78	68	4	38	69	*a* 2.71	54
4	39.6	112	3.60	201	5	36	62	*b* 2.60	40
5	39.6	96	3.31	143	5	38	68	2.53	39
6	39.6	97	3.32	138	6	38	66	2.51	35
7	38	87	2.98	88	7	38	70	2.60	50
8	38	79	2.84	73	8	38	70	2.61	48
9	38	87	2.96	92	9	38	70	2.60	48
10	38	87	2.98	99	10	38	70	2.64	51
11	38	83	2.88	80	11	38	72	2.59	45
12	38	94	3.19	134	12	38	70	2.64	51
13	38	94	3.21	127	13	38	59	2.58	49
14	39.6	110	3.57	190	13	38	59	2.58	48
15	39.6	96	3.33	140	14	38	59	2.58	46
16	38	94	3.21	129	16	38	59	2.62	48
17	39.6	98	3.44	163	17	37.5	57	2.52	36
18	39.6	114	3.70	205	18	38	59	2.2	49
19	39.6	110	3.61	196	19	37.5	56	2.54	41
20	39.6	101	3.37	153	20	36	45	2.16	15
21	39.6	106	3.49	170	21	38	67	2.80	74
22	38	103	3.36	157	22	38	59	2.59	40
23	38	102	3.32	135	23	38	63	2.69	56
24	38	86	3.22	116	24	38	59	2.60	45
25	38	89	3.12	109	25	37.5	54	2.53	39
26	38	93	3.20	118	26	37.5	56	2.51	40
27	38	89	3.10	101	28	38	70	2.92	68
28	38	85	3.03	91	29	38	59	2.61	45
29	38	89	2.98	86	30	38	63	2.66	53
30	38	85	2.96	90	Dec. 1	38	77	2.93	75
Oct. 1	38	81	2.91	81	2	37	49	2.28	24
2	38	81	2.90	76	3	38	59	2.58	42
3	38	81	2.90	79	6	37	67	2.84	26
4	38	74	2.69	61	8	36.5	66	2.69	37
5	38	74	2.66	55	9	38	69	2.76	61
6	38	74	2.66	56	10	37.5	65	2.71	56
7	38	77	2.83	72	11	38	58	2.68	43
8	38	77	2.80	70	12	38	55	2.67	46
9	38	77	2.76	63	13	38	39	2.26	19
10	38	74	2.73	57	14	38	36	2.20	15
11	38	73	2.70	56	15	38	77	3.38	42
12	38	70	2.58	45	16	38	65	3.22	46
13	38	70	2.60	47	17	38	70	3.24	40
14	38	70	2.62	48	18	38	50	2.84	34
15	38	70	2.64	52	19	38	58	3.02	43
16	38	73	2.69	51	20	38	50	2.79	37
17	38	77	2.78	63	22	38	47	2.71	38
18	38	81	2.91	76	24	38	70	3.27	50
20	38	74	2.70	55	25	38	52	2.89	39
21	38	81	2.92	83	26	38	46	2.76	35
22	38	78	2.76	63	27	38	62	3.34	43
23	38	77	2.80	67	30	38	41	2.76	26
24	38	75	2.71	56					

a Thin ice. *b* Thin ice and slush at edges; probably not enough to affect results.

Daily gage height, in feet, of Cache la Poudre River near Elkhorn, Colo., for 1910.

[Norman W. Fry, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.1	2.65	2.8	2.6	4.1	6.0	4.5	3.55	2.8	2.90	2.70	2.35
2	2.75	2.65	2.75	2.5	3.9	6.2	4.35	3.45	2.75	2.90	2.70	2.30
3	2.75	2.65	2.85	2.55	3.8	6.15	4.25	3.35	2.8	2.90	2.65	2.60
4	2.7	2.7	2.6	2.55	3.9	6.15	4.25	3.25	3.6	2.70	2.80	2.40
5	2.9	2.6	2.7	2.6	4.25	6.0	4.4	3.3	3.3	2.65	2.55	2.60

Daily gage height, in feet, of Cache la Poudre River near Elkhorn, Colo., for 1910—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
6	3.6	2.5	2.4	2.5	4.1	5.7	4.15	3.2	3.3	2.65	2.50	2.85
7	2.9	2.5	2.7	2.55	3.95	5.6	4.05	3.1	3.0	2.85	2.60	2.80
8	2.8	2.55	2.75	2.55	3.9	5.55	4.0	3.05	2.85	2.80	2.60	2.70
9	2.65	2.6	2.6	2.65	4.4	5.5	3.95	3.0	2.95	2.75	2.60	2.75
10	2.75	2.8	2.3	2.75	4.9	5.3	3.9	3.0	3.0	2.75	2.65	2.70
11	2.7	2.65	2.6	2.8	5.0	5.2	3.85	3.0	2.9	2.70	2.60	2.70
12	2.75	2.6	2.2	2.8	5.1	5.3	3.75	3.05	3.2	2.60	2.65	2.65
13	3.6	2.6	2.35	2.8	5.05	5.25	3.7	3.15	3.2	2.60	2.60	2.25
14	3.15	2.5	2.4	2.8	5.0	5.45	3.65	3.2	3.55	2.60	2.60	2.20
15	2.6	2.75	2.4	2.75	5.0	5.3	3.6	3.15	3.35	2.65	2.65	3.40
16	2.55	2.4	2.35	2.8	4.5	5.2	3.6	3.0	3.2	2.70	2.60	3.20
17	2.55	2.6	2.5	2.65	4.3	5.1	3.65	2.95	3.45	2.80	2.50	3.25
18	2.7	2.4	2.5	2.75	4.4	5.2	3.8	2.9	3.7	2.90	2.60	2.85
19	2.55	2.5	2.5	2.85	4.45	5.0	3.7	2.9	3.6	2.85	2.55	3.00
20	2.45	2.45	2.5	3.05	4.6	5.0	3.75	2.85	3.35	2.70	2.15	2.80
21	2.5	2.55	2.5	3.35	4.5	5.0	3.7	2.9	3.5	2.90	2.80	2.90
22	2.45	2.45	2.5	3.15	4.4	4.75	3.65	2.9	3.35	2.75	2.60	2.70
23	2.45	2.55	2.6	3.10	4.45	4.75	3.55	2.9	3.3	2.80	2.70	3.20
24	2.55	2.65	2.5	3.3	4.65	4.55	3.45	2.85	3.2	2.70	2.60	3.25
25	2.5	2.7	2.5	3.55	4.8	4.45	3.35	2.8	3.1	2.70	2.55	2.90
26	2.4	2.7	2.6	3.6	4.9	4.5	3.3	2.75	3.2	2.75	2.55	2.75
27	2.5	2.8	2.55	3.85	4.95	4.45	3.25	2.9	3.1	2.75	2.35	3.35
28	2.5	2.55	2.5	4.2	5.55	4.4	3.7	3.1	3.05	2.65	2.90	3.00
29	2.5	.....	2.4	4.55	5.9	4.5	3.7	2.95	3.0	2.70	2.60	2.80
30	2.8	.....	2.6	4.5	6.05	4.6	4.1	2.9	2.95	2.65	2.65	2.75
31	2.65	.....	2.85	.....	5.95	.....	3.65	2.8	.....	2.70	.....	2.85

NOTE.—Ice Jan. 1 to Mar. 10 and Dec. 6 to 31.

Daily discharge, in second-feet, of Cache la Poudre River near Elkhorn, Colo., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	43	28	24	46	350	a1,480	510	195	68	80	56	27
2	32	29	26	38	288	a1,590	445	173	62	80	56	24
3	34	30	30	42	256	1,430	405	152	68	80	51	46
4	34	29	32	42	288	1,430	405	133	206	56	68	30
5	32	29	49	46	405	1,320	465	142	142	51	42	46
6	32	26	30	38	350	1,100	368	124	142	51	38	26
7	30	27	54	42	303	1,020	334	108	94	74	46	31
8	30	26	59	42	288	992	318	101	74	68	46	37
9	28	25	45	51	465	960	303	94	87	62	46	61
10	28	23	24	62	a 616	835	288	94	94	62	51	56
11	26	22	46	68	a 716	780	270	94	80	56	46	43
12	26	25	20	68	a 807	835	243	101	124	46	51	46
13	32	27	27	68	a 754	808	230	116	124	46	46	19
14	32	22	30	68	a 684	927	218	124	195	46	46	15
15	30	22	30	62	a 669	835	206	116	152	51	51	42
16	33	24	27	68	510	780	206	94	124	56	46	46
17	30	26	38	51	425	725	218	87	173	68	38	40
18	25	29	38	62	465	780	256	80	230	80	46	34
19	24	29	38	74	488	675	230	80	206	74	42	43
20	21	27	38	101	555	675	243	74	152	56	19	37
21	23	25	38	152	510	a 675	230	80	184	80	68	38
22	24	23	38	116	465	a 595	218	80	152	62	46	38
23	29	21	46	108	488	a 588	195	80	142	68	56	44
24	31	23	38	142	580	532	173	74	124	56	46	50
25	30	24	38	195	a 607	487	152	68	108	56	42	39
26	20	26	46	206	625	510	142	62	124	62	42	35
27	22	27	42	272	650	488	133	80	108	62	27	43
28	25	21	38	385	992	465	230	108	101	51	80	38
29	30	.....	30	532	a1,240	510	230	87	94	56	46	32
30	23	.....	46	510	a1,530	555	350	80	87	51	51	26
31	25	.....	74	.....	a1,440	.....	218	68	.....	56	.....	26

a Discharge measurement used.

NOTE.—These discharges are based on rating curves applicable as follows, except as indicated in footnote above: Mar. 11 to May 24 and June 24 to Dec. 5, well defined below 765 second-feet; May 26 to June 21, fairly well defined. Discharges estimated or interpolated Jan. 4 to 11, 27, Feb. 2, 12, 15 to 18, 20 to 22, Dec. 7, 21, 23, 28, 29, and 31. Discharges obtained from discharge measurements for other days, Jan. 1 to Mar. 11 and Dec. 6 to 31.

Monthly discharge of Cache la Poudre River near Elkhorn, Colo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	43	20	28.5	1,750	A.
February	30	21	25.5	1,420	A.
March	74	20	38.0	2,340	A.
April	532	38	125	7,440	A.
May	1,530	256	607	37,300	B.
June	1,590	465	846	50,300	B.
July	510	133	272	16,700	A.
August	195	62	102	6,270	A.
September	230	62	127	7,560	A.
October	80	46	61.4	3,780	A.
November	80	19	47.5	2,830	A.
December	61	15	37.4	2,300	A.
The year	1,590	15	193	140,000	

CACHE LA POUDRE RIVER NEAR FORT COLLINS, COLO.

This station, which was established January 8, 1909, to determine the amount of water available for storage, irrigation, and power development, is situated about 1,000 feet below the Fort Collins waterworks intake, 16 miles above Fort Collins, and 500 yards above the mouth of the North Fork of the Cache la Poudre.

The station is below all tributaries above the North Fork.

Practically no water is diverted from the main stream or its tributaries above the station, with the exception of that taken for the Fort Collins water supply.

Discharge measurements are taken from a cable about 120 yards downstream from the vertical rod gage, which is driftbolted to a cliff on the left bank, and which has remained constant. Winter and low-water measurements are made by wading.

Ice affects the gage heights for several months each winter.

All of the ordinary flow and a considerable proportion of the flood waters have been filed upon for irrigation below, but if the flood waters are stored opportunities for power development will be afforded.

The proposed Elkhorn reservoir, the dam for which is to be located 2 miles below the mouth of Elkhorn Creek, will have a capacity of 113,000 acre-feet with a dam 400 feet high, and the proposed Stove Prairie reservoir, located 8 miles above the gaging station, will have a capacity of 26,500 acre-feet with a dam 200 feet high.

During 1909 and 1910 frequent measurements were made by parties cooperating with the United States Geological Survey through George B. McFadden, an engineer of Denver, Colo. Computations of daily and monthly discharges have been made by engineers of the United States Geological Survey. In developing the rating table for this station for 1909 the discharge measurements were considered in groups, as the channel conditions are permanent, though rough. For 1910 individual measurements were plotted, properly weighted, and a rating curve developed.

Discharge measurements of Cache la Poudre River near Fort Collins, Colo., in 1910.

[By engineers of the United States Geological Survey.]

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 5[a]	G. J. Lyon	40	37	2.0	52
June 1[b]	Bolster and Freeman	75	342	5.75	1,910
28[a]	Freeman and Turner	73	167	3.72	561
Oct. 9[a]	Padgett and Miles	51	57	2.20	77

[a] Wading measurement. [b] From cable.

Discharge measurements of Cache la Poudre River near Fort Collins, Colo., in 1910.

[By Fred Stearley.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 1	2.70	55	Mar. 12	2.00	65	Aug. 7	2.7	178
2	2.65	52	13	2.05	79	8	2.5	147
3	2.70	55	14	1.90	56	11	2.5	132
4	2.75	60	15	1.90	53	15	2.7	176
5	2.60	54	19	1.95	59	18	2.45	139
6	2.70	56	23	2.15	90	22	2.35	114
7	2.50	48	24	2.12	89	27	2.25	95
8	2.45	43	27	2.10	81	31	2.3	104
9	2.40	36	30	1.90	50	Sept. 2	2.2	92
10	2.60	52	31	2.20	100	5	2.8	182
11	2.60	54	Apr. 1	2.25	105	7	2.5	143
12	2.70	61	4	2.01	152	10	2.4	116
13	2.70	62	7	2.10	172	14	2.7	184
14	2.75	68	11	2.20	164	17	2.5	143
15	2.75	68	14	2.30	116	22	2.8	205
16	2.80	75	16	2.25	102	28	2.5	134
17	2.75	58	18	2.20	96	Oct. 3	2.35	108
18	2.70	54	22	2.75	182	6	2.2	88
19	2.62	53	23	2.60	159	8	2.3	97
20	2.60	53	24	2.50	153	11	2.15	86
21	2.65	44	27	3.25	409	15	2.10	82
22	2.65	43	28	3.65	515	18	2.3	102
23	2.65	58	29	4.0	654	21	2.2	93
24	2.65	54	May 2	3.4	354	25	2.15	86
25	2.65	53	5	3.7	466	27	2.15	88
26	2.50	42	7	3.3	348	29	2.2	95
27	2.50	43	10	4.25	789	Nov. 1	2.1	82
28	2.50	41	11	4.5	938	3	2.1	85
29	2.50	43	12	4.65	1,040	6	2.0	75
30	2.45	41	15	4.3	788	8	2.2	96
31	2.45	43	20	3.8	564	11	2.1	82
Feb. 1	2.49	42	25	4.4	882	13	2.05	73
2	2.42	41	29	5.2	1,274	16	2.05	74
3	2.45	43	June 6	5.2	1,260	19	2.1	83
4	2.30	38	9	4.7	1,090	21	1.9	56
5	2.40	38	12	4.6	988	24	1.9	58
6	2.40	38	15	4.6	1,040	27	2.1	63
7	2.30	38	18	4.2	722	30	2.4	70
8	2.40	38	22	4.1	697	Dec. 2	2.0	61
9	2.20	37	25	3.9	652	5	1.85	54
10	2.30	37	28	3.7	500	8	1.9	53
12	2.45	41	July 1	3.7	510	11	2.1	40
15	2.10	32	5	3.5	392	13	1.95	55
17	1.80	28	10	3.2	405	16	1.9	51
19	2.40	48	15	3.0	222	19	1.9	49
22	2.30	36	18	3.2	316	21	2.0	40
26	2.42	49	22	3.0	222	25	2.0	39
28	2.30	37	25	2.8	217	27	2.06	34
Mar. 1	2.25	52	30	3.45	437	29	1.9	48
4	1.95	60	Aug. 3	2.8	188	31	2.3	32
8	2.20	97						

NOTE.—Ice Jan. 1 to Mar. 1 and Nov. 27 to 31. Beginning Apr. 27 the hydrographer used 0.2 and 0.6 depth method instead of 0.2 and 0.8 depth method. Measurements Apr. 27 to July 22, July 30, Aug. 3, Sept 2, 14, and 22 have been corrected from the original current meter notes using the recorded velocities for the 0.6 points. These measurements, however, are not as reliable as other measurements made by the 0.2 and 0.8 depth method.

Daily gage height, in feet, of Cache la Poudre River near Fort Collins, Colo., for 1910.

[Fred Stearley, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.7	2.45	2.25	2.25	3.45	5.75	3.75	3.05	2.2	2.4	2.1	2.15
2	2.65	2.4	2.25	2.1	3.4	6.0	3.7	2.95	2.2	2.35	2.15	1.95
3	2.7	2.4	2.05	2.05	3.35	5.8	3.6	2.8	2.2	2.3	2.1	1.9
4	2.7	2.35	2.0	1.95	3.55	5.5	3.5	2.65	2.4	2.3	2.15	1.9
5	2.7	2.4	1.95	1.9	3.75	4.95	3.5	2.6	2.75	2.25	2.15	1.7
6	2.7	2.4	2.1	1.95	3.45	5.15	3.4	2.7	2.6	2.2	2.05	1.55
7	2.5	2.3	2.1	2.1	3.3	5.0	3.4	2.65	2.45	2.2	2.0	1.75
8	2.4	2.35	2.2	2.1	3.4	4.8	3.3	2.5	2.35	2.25	2.2	1.9
9	2.45	2.2	2.1	2.1	3.85	4.65	3.25	2.45	2.3	2.2	2.1	2.05
10	2.6	2.35	1.9	2.2	4.25	4.55	3.2	2.5	2.4	2.2	2.0	2.15
11	2.6	2.4	2.05	2.2	4.35	4.45	3.15	2.55	2.3	2.15	2.1	2.0
12	2.7	2.45	2.0	2.3	4.65	4.45	3.1	3.05	2.3	2.1	2.1	1.95
13	2.7	2.4	2.0	2.25	4.45	4.55	3.1	2.8	2.85	2.1	2.0	1.9
14	2.75	2.35	1.9	2.3	4.3	4.6	3.0	2.7	2.65	2.1	2.0	1.9
15	2.75	2.1	1.9	2.25	4.25	4.55	3.0	2.65	2.6	2.1	2.0	1.9
16	2.85	2.05	1.9	2.3	4.15	4.45	3.05	2.5	2.5	2.2	2.05	1.9
17	2.75	1.8	1.9	2.2	3.7	4.35	3.1	2.45	2.5	2.3	2.0	1.9
18	2.7	2.3	1.9	2.2	3.8	4.2	3.15	2.4	2.85	2.3	2.0	2.0
19	2.65	2.4	2.0	2.25	3.9	4.2	3.1	2.4	2.9	2.2	2.05	1.9
20	2.6	2.4	2.0	2.4	3.7	4.2	3.1	2.3	2.8	2.2	2.0	1.9
21	2.7	2.4	2.1	2.65	3.85	4.15	3.05	2.3	2.8	2.2	1.9	1.95
22	2.65	2.3	2.1	2.7	3.85	4.05	3.0	2.35	2.8	2.1	2.2	1.9
23	2.65	2.4	2.15	2.6	4.05	4.0	2.95	2.4	2.8	2.15	2.0	2.0
24	2.65	2.45	2.15	2.55	4.2	4.0	2.9	2.3	2.7	2.1	1.9	2.0
25	2.6	2.45	2.1	2.85	4.35	3.85	2.75	2.3	2.7	2.15	1.9	2.0
26	2.5	2.45	2.1	2.95	4.25	3.8	2.7	2.2	2.55	2.15	2.0	2.0
27	2.5	2.3	2.1	3.15	4.25	3.8	2.7	2.25	2.5	2.15	2.1	2.0
28	2.5	2.3	2.05	3.75	4.65	3.7	2.85	2.3	2.5	2.2	2.25	1.95
29	2.5	.....	1.95	3.9	5.0	3.7	3.15	2.3	2.5	2.2	2.4	1.9
30	2.45	.....	1.8	3.65	5.55	4.1	3.45	2.4	2.4	2.1	2.35	2.1
31	2.5	.....	2.15	.....	5.9	.....	3.15	2.3	.....	2.1	.....	2.25

NOTE.—Ice Jan. 1 to Mar. 1, Nov. 27 to Dec. 31.

Daily discharge, in second-feet, of Cache la Poudre River near Fort Collins, Colo., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	55	42	52	93	405	1,910	532	269	86	116	74	65
2	52	41	52	74	386	2,150	510	240	86	108	80	61
3	55	43	57	68	368	1,960	465	200	86	100	74	59
4	60	38	62	56	445	1,680	424	165	116	100	80	56
5	54	38	56	50	532	1,250	424	154	188	93	80	54
6	56	38	74	56	405	1,400	386	176	154	86	68	54
7	48	38	74	74	350	1,290	386	165	125	86	62	53
8	43	38	86	74	386	1,140	350	134	108	93	86	53
9	36	37	74	74	580	1,040	333	125	100	86	74	49
10	52	37	50	86	795	978	315	134	116	86	62	44
11	54	39	68	86	855	915	300	144	100	80	74	40
12	61	41	62	100	1,040	915	284	269	100	74	74	48
13	62	38	62	93	915	978	284	200	213	74	62	55
14	68	35	50	100	825	1,010	254	176	165	74	62	53
15	68	32	50	93	795	978	254	165	154	74	62	52
16	75	30	50	100	738	915	269	134	134	86	68	51
17	58	28	50	86	510	855	284	125	134	100	62	50
18	54	38	50	86	555	765	300	116	213	100	62	50
19	53	48	62	93	605	765	284	116	226	86	68	49
20	53	44	62	116	510	765	284	100	200	86	62	45
21	44	40	74	165	580	738	269	100	200	86	50	40
22	43	36	74	176	580	682	254	108	200	74	86	40
23	58	40	80	154	682	655	240	116	200	80	62	40
24	54	43	80	144	765	655	226	100	176	74	50	39
25	53	46	74	213	855	580	188	100	176	80	50	39

Daily discharge, in second-feet, of Cache la Poudre River near Fort Collins, Colo., for 1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	42	49	74	240	795	555	176	86	144	80	62	36
27	43	43	74	300	795	555	176	93	134	80	63	34
28	41	37	68	532	1,040	510	213	100	134	86	65	41
29	43	.....	56	605	1,290	510	300	100	134	86	68	48
30	41	.....	40	488	1,730	710	405	116	116	74	70	40
31	43	.....	80	.....	2,060	.....	300	100	.....	74	.....	32

NOTE.—These discharges are based on a fairly well-defined rating curve between 50 and 2,150 second-feet, except as noted. Discharges Jan. 1 to Mar. 1 and Nov. 27 to Dec. 31, discharge measurements used, and discharges between measurements estimated. Discharge estimated Mar. 2 and 3.

Monthly discharge of Cache la Poudre River near Fort Collins, Colo., for 1910.

[Drainage area, 495 square miles.]

Month.	Discharge in second-feet.			Per square mile.	Depth in inches on drainage area.	Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.				
January	75	36	52.3	0.106	0.12	3,220	A.
February	49	28	39.2	.079	.08	2,180	A.
March	86	46	63.8	.129	.15	3,920	A.
April	605	50	156	.315	.35	9,280	A.
May	2,060	350	747	1.51	1.74	45,900	A.
June	2,150	510	994	2.01	2.24	59,100	A.
July	532	176	312	.630	.73	19,200	A.
August	269	86	143	.289	.33	8,790	A.
September	226	86	147	.297	.33	8,750	A.
October	116	74	85.9	.274	.20	5,280	A.
November	86	50	67.4	.136	.15	4,010	A.
December	65	32	47.4	.096	.11	2,910	A.
The year	2,150	28	238	.481	6.53	173,000	

CACHE LA POUDRE RIVER AT MOUTH OF CANYON, NEAR FORT COLLINS, COLO.

From 1884 to 1901 a careful study of the regimen of this stream at this point was carried on under the direction of Prof. L. G. Carpenter, of the Colorado State Agricultural College, and the results of his study were published in the reports of the United States Geological Survey.[1] On November 30, 1909, a Bristol automatic gage was installed about 2 miles below the intake of the Fort Collins waterworks, 12 miles from Fort Collins, about half a mile below the head gate of the Poudre Valley ditch, in the NE. $\frac{1}{4}$ sec. 15, T. 8 N., R. 70 W. An auxiliary sloping staff gage, used to set the automatic gage, was also installed. Continuous gage-height records did not commence until May 8, 1910.

The drainage area above the station comprises about 1,060 square miles.

The banks of stream are the remains of the wall of the old flume. The stream runs in one channel, not liable to shift.

Measurements are made from a car and cable at the gage.

The bed at the measuring section is composed of round bowlders and gravel and is fairly uniform. Results should be good.

[1] See Water-Supply Paper U. S. Geol. Survey No. 119, 1905, p. 42.

Considerable water is diverted for irrigation above this station.

Gage heights are somewhat affected by ice during the winter.

This station is now maintained by the State engineer of Colorado, who has furnished the data for publication.

Discharge measurements of Cache la Poudre River at mouth of canyon, near Fort Collins, Colo., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 3[a]	C. L. Chatfield	90	97	1.69	60
Mar. 18[b]	....do	94	160	1.11	98
25[b]	....do	95	179	1.28	146
Apr. 19[b]	Thomas Grieve	94	175	1.28	148
May 11	....do	98	305	2.65	936
June 9	C. C. Hezmalhalch	98	334	2.88	1,210
23	....do	100	294	2.55	818
28	Freeman and Miles	97	247	2.02	496
July 15[b]	Thomas Grieve	99	210	1.60	268
Aug. 5[b]	C. C. Hezmalhalch	100	195	1.42	196
Sept 27[b]	C. L. Chatfield	95	185	1.35	167
Dec. 5[c]	C. C. Hezmalhalch	.....	131	.97	436

[a] Made through ice. [b] Made from cable. [c] Ice conditions.

Daily gage height, in feet, of Cache la Poudre River at mouth of canyon, near Fort Collins, Colo., for 1910.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.4	2.0	1.5	1.05	1.3	1.1	0.95
2	.....	3.45	1.95	1.45	1.05	1.45	1.2	1.05
3	.....	3.45	1.85	1.4	1.1	1.4	1.25	1.05
4	.....	3.45	1.8	1.25	1.2	1.4	1.1	1.1
5	.....	2.95	1.85	1.3	1.4	1.2	1.1	.8
6	.....	2.85	1.85	1.35	1.25	1.15	1.15	.7
7	.....	2.9	1.7	1.3	1.2	1.2	1.15	.7
8	1.8	2.8	1.7	1.2	1.05	1.25	1.3	.8
9	2.05	2.75	1.55	1.15	1.1	1.3	1.2	1.0
10	2.25	2.7	1.65	1.2	1.2	1.35	1.1	.9
11	2.65	2.7	1.6	1.3	1.1	1.45	1.2	.95
12	2.7	2.65	1.55	1.3	1.2	1.45	1.25	.9
13	2.65	2.65	1.5	1.4	1.4	1.4	1.1	.8
14	2.55	2.7	1.5	1.35	1.45	1.3	1.05	.8
15	2.5	2.65	1.5	1.3	1.4	1.4	1.0	.7
16	2.4	2.55	1.5	1.25	1.35	1.55	1.0	.8
17	2.25	2.5	1.5	1.15	1.3	1.55	1.10	.8
18	2.3	2.5	1.65	1.15	1.45	1.4	1.1	.9
19	2.3	2.5	1.5	1.15	1.5	1.1	1.15	.85
20	2.3	2.5	1.6	1.1	1.55	1.15	1.05	.85
21	2.35	2.4	1.6	1.1	1.5	1.2	1.0	.9
22	2.3	2.35	1.55	1.15	1.45	1.2	1.05	.7
23	2.3	2.25	1.5	1.15	1.5	1.2	1.2	.7
24	2.35	2.2	1.45	1.05	1.5	1.2	1.0	1.0
25	2.55	2.15	1.4	1.05	1.35	1.35	1.15	.....
26	2.55	2.0	1.35	1.05	1.3	1.25	1.15	.....
27	2.6	1.9	1.25	1.05	1.25	1.1	1.05	.....
28	2.85	1.85	1.3	1.1	1.2	1.1	1.10	.....
29	3.1	1.95	1.55	1.15	1.2	1.15	.90	.....
30	3.15	2.1	1.8	1.1	1.2	1.2	.95	.....
31	3.3	.....	1.65	1.1	.....	1.2	.....	.....

NOTE.—Ice during December.

Daily discharge, in second-feet, of Cache la Poudre River at mouth of canyon, near Fort Collins, Colo., for 1910.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1,750	465	220	85	150	95	.....
2	.....	1,810	438	202	85	202	120	.....
3	.....	1,810	382	185	95	185	135	.....
4	.....	1,810	355	135	120	185	95	.....
5	.....	1,250	382	150	185	120	95	.....
6	.....	1,150	382	168	135	108	108	.....
7	.....	1,200	305	150	120	120	108	.....
8	355	1,100	305	120	85	135	150	.....
9	498	1,050	240	108	95	150	120	.....
10	632	1,000	282	120	120	168	95	.....
11	958	1,000	260	150	95	202	120	.....
12	1,000	958	240	150	120	202	135	.....
13	958	958	220	185	185	185	95	.....
14	872	1,000	220	168	202	150	85	.....
15	830	958	220	150	185	185	75	.....
16	745	872	220	135	168	240	75	.....
17	632	830	220	108	150	240	95	.....
18	670	830	282	108	202	185	95	.....
19	670	830	220	108	220	95	108	.....
20	670	830	260	95	240	108	85	.....
21	708	745	260	95	220	120	75	.....
22	670	708	240	108	202	120	85	.....
23	670	632	220	108	220	120	120	.....
24	708	595	202	85	220	120	75	.....
25	872	562	185	85	168	168	108	.....
26	872	465	168	85	150	135	108	.....
27	915	410	135	85	135	95	85	.....
28	1,150	382	150	95	120	95	95	.....
29	1,410	438	240	108	120	108	60	.....
30	1,465	530	355	95	120	120	68	.....
31	1,630	.....	282	95	.....	120	.....	.....

Monthly discharge of Cache la Poudre River at mouth of canyon, near Fort Collins, Colo., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
May 8-31	1,630	355	857	40,800
June	1,810	382	949	56,500
July	465	135	269	16,500
August	220	85	128	7,870
September	220	85	152	9,040
October	240	95	154	9,470
November	150	60	98.9	5,890
December	.....	.....	[a] 45	2,770
The period	.....	.....	.....	149,000

[a] Estimated.

NOTE.—These values have been changed slightly to conform to the computation rules of the United States Geological Survey.

LOUP RIVER BASIN

DESCRIPTION

The Loup and its branches, which form the most important tributaries of the Platte below the forks, drain an area 13,540 square miles in extent, lying in the heart of Nebraska. The Loup proper is formed by the junction of North and Middle Loup rivers, which unite near the city of St. Paul, the middle Loup in turn receiving the South Loup in the southwestern part of Howard County. The principal

tributaries are Beaver, Cedar, Calamus, and Dismal creeks. A comparatively small amount of water is diverted for irrigation, the ditches generally being small and covering limited areas. A number of power plants are in operation and others of considerable extent have been proposed, particularly one near Columbus, by which it is believed that about 20,000 continuous horsepower may be developed.

On Loup River the flow was probably lowest in 1895.

The following special report contains information regarding the hydrography of this basin:

Surface waters of Nebraska, by J. C. Stevens: Water-Supply Paper U. S. Geol. Survey No. 230, 1909.

LOUP RIVER AT COLUMBUS, NEBR.

This station, which was established October 13, 1894, is located at the highway bridge in the outskirts of Columbus and about 3 miles above the mouth of the river, in sec. 25, T. 17 N., R. 1 W.

The records show the total discharge of the river at its mouth, and are valuable in connection with power development. They show also the remarkably uniform flow of the stream. A comparatively small amount of water is diverted for irrigation.

Records have usually been suspended during the winter months on account of the severe ice conditions.

Measurements at this station are rough at best, owing to the soft and constantly shifting bed and the high and uneven velocity. Gage heights are only an approximate index of discharge, as the swift current changes the channel very rapidly, and at least one measurement a week would be required to give even fairly good results.

No daily discharges have been computed for 1910, as any computation based on the data at hand would be misleading, and a fair idea of the discharge can be obtained from the discharge measurements. Two gages have been used at this station: A chain gage at the highway bridge has been used since 1904; and a staff gage at the former cable location, 1½ miles above, was used prior to that time. The datum of the staff gage is 8.56 feet above the present gage datum. Otherwise, no changes in datum have been made. Discharge measurements are made from the highway bridge to which the gage is attached.

Discharge measurements of Loup River at Columbus, Nebr., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 20	D. D. Price	210	687	4.40	2,280
May 10	do	340	906	4.60	3,190
25	do	346	888	4.50	2,930
June 24	do	380	642	4.20	1,780
July 25	do	520	788	4.54	2,100
Aug. 31	do	410	1,010	5.40	3,590
Oct. 1	A. A. Dolson	350	753	4.45	2,120
Nov. 19	do	390	696	4.30	2,230
25	do	402	714	4.28	2,420

Daily gage height, in feet, of Loup River at Columbis, Nebr., for 1910.

[W. D. Benson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.35	4.3	4.5	4.55	4.35	5.55	4.4	4.55	4.2
2	.....	4.35	4.5	.....	4.35	4.4	4.1	4.3	4.6	4.35
3	.....	4.35	4.95	4.5	4.6	4.4	4.3	4.55	4.5	4.4
4	.....	4.45	4.95	4.5	4.6	4.4	4.3	4.55	4.3	4.35
5	.....	4.5	.....	4.5	4.75	4.45	4.25	4.5	4.1	.....
6	.....	4.55	.....	4.6	4.55	4.45	4.2	4.5	4.25	.....
7	.....	4.6	.....	4.75	4.85	4.5	4.2	.....	4.1	.....
8	.....	.....	.....	4.85	5.0	4.6	4.1	4.45	4.2	.....
9	.....	.....	.....	5.25	4.6	4.5	4.1	4.0	4.2	.....
10	.....	4.55	4.55	5.3	4.5	4.5	4.1	4.45	4.25	.....
11	.....	4.6	4.45	4.95	4.45	4.65	4.1	4.45	4.3	.....
12	4.65	4.6	4.5	4.8	4.4	4.65	4.1	4.45	4.25	.....
13	4.4	4.55	4.6	4.7	4.5	4.9	4.15	4.45	4.2	.....
14	4.3	4.7	4.65	4.5	4.4	5.65	4.2	4.45	4.25	.....
15	4.3	4.8	4.6	4.35	4.4	5.1	4.2	4.45	4.2	.....
16	4.45	4.85	4.55	4.3	4.4	5.3	4.3	4.5	4.15	.....
17	4.35	4.7	4.55	.....	4.4	5.4	4.25	4.55	4.1	.....
18	4.25	4.65	4.6	4.4	4.35	5.65	4.35	4.6	4.2	.....
19	4.3	4.3	4.65	4.4	4.3	5.2	4.3	4.6	4.4	.....
20	4.3	4.45	4.55	4.4	4.35	4.75	4.3	4.55	4.45	.....
21	4.3	4.4	4.65	4.4	4.35	4.4	.....	.....	4.4	.....
22	4.3	4.45	4.65	4.35	4.3	4.3	4.35	4.5	4.4	.....
23	4.45	4.4	4.75	4.3	4.4	4.25	4.4	4.3	4.3	.....
24	4.3	4.4	4.7	4.3	4.45	4.2	4.5	4.3	4.3	.....
25	4.35	4.35	4.65	4.5	4.5	4.1	4.5	4.3	4.25	.....
26	4.45	4.4	4.4	5.3	4.45	4.1	4.55	4.4	4.3	.....
27	4.45	4.4	4.55	5.05	4.4	4.05	4.6	4.5	4.35	.....
28	4.45	4.5	4.6	4.8	4.35	4.1	4.55	4.55	4.4	.....
29	4.5	4.55	4.6	4.5	4.25	5.0	4.5	4.7	4.25	.....
30	4.4	4.5	4.6	4.5	4.25	5.4	4.4	4.6	4.2	.....
31	4.35	4.55	4.5	.....	4.25	5.55	.....	4.6	.....	.....

NOTE.—Ice conditions Jan. 1 to Mar. 11 and Dec. 5 to 31.

KANSAS RIVER BASIN.

DESCRIPTION.

The drainage basin of Kansas River lies between the basins of the Platte and the Arkansas, entirely within the region of the Great Plains. The Kansas as such is a comparatively short stream, being formed by the union of Smoky Hill and Republican rivers in Geary County, Kans., whence it flows eastward, entering the Missouri at Kansas City, Mo.

The Smoky Hill rises near the boundary between Kansas and Colorado, pursues a winding but on the whole easterly course through Kansas, and near Junction unites with the Republican. Its length is 335 miles and the extreme width of its basin is about 100 miles. The river runs close to the northern border of the Arkansas basin, and its chief tributaries are from the north. Solomon and Saline rivers are the most important, the former draining the northern part of Kansas and the latter the territory between the Solomon and the Smoky Hill.

Republican River rises in the arid plains of eastern Colorado, flows northeastward into southwestern Nebraska, then eastward through

the southern tier of counties to Superior, where it turns to the southeast, enters Kansas, and finally joins the Smoky Hill. The length of the basin east and west is approximately 360 miles, its greatest width is 120 miles, and the total area drained is 25,840 square miles. The river is wide and rather shallow, with a rapid descent, and the bed is largely shifting quicksand of the most unstable character. In its upper course the Republican receives many tributaries, chiefly from the south. Nearly all of these flow through a region where the rainfall is less than 22 inches, but as this part of the basin is covered with buffalo grass, which sheds rain like a roof, the per cent of rainfall reaching the streams is great. Near the mouth the drainage area is very narrow and the tributaries are small and unimportant, but here the rainfall is 28 to 30 inches a year. Many small springs are found along the Republican and its branches, and the ground water generally lies at medium depth. The soil of the middle part of the basin is porous, sandy loam, and about 55 per cent of the land is under cultivation; along the lower course the soil is black loam and clay, and about 75 per cent of the land is cultivated. The rainfall in the lower basin is considered sufficient for all growing crops. The Republican is subject to sudden rises and falls and occasionally overflows its banks.

The most important feeder of the Kansas below the junction of Smoky Hill and Republican rivers is the Blue, which rises in southeastern Nebraska, flows to the southeast and south into Kansas, and joins Kansas River at Manhattan. The principal tributary of the Blue is the Little Blue, which rises in southern Nebraska, flows southeastward, and unites with the main stream near Blue Rapids.

The basin of the Kansas comprises the richest portion of the State of Kansas. The section is under a high state of cultivation and produces a great variety of crops. The river flows through a rich alluvial bottom land, and bottoms and rolling uplands are well timbered with oak, cottonwood, ash, elm, hickory, etc. The banks are sandy and easily cave in. In places the bed contains rock and bowlders, but in general it is composed of sand and at many places of quicksand. The channel as a rule hugs one bank or the other and is somewhat shifting. Islands are formed here and there by the deposit of sediment during high water, drift lodges upon them, and a thick growth of brush, mainly cottonwood, soon springs up. At Topeka the river is 900 feet wide between banks. At ordinary low water the channel occupies 150 to 200 feet of this width and has a depth of 8 to 9 feet; at mean high water the average depth is probably 10 feet for the entire distance between banks.

The following special report contains information regarding the hydrography of Kansas River basin:

Surface waters of Nebraska, by J. C. Stevens: Water-Supply Paper U. S. Geol. Survey No. 230, pp. 175–220, 1909.

REPUBLICAN RIVER AT BOSTWICK, NEBR.

This station, which is located at a highway bridge 1 mile north of Bostwick, Nebr., in Sec. 23, T. 1 N., R. 8 W., was established June 6, 1904, to replace the station at Superior, Nebr., which had been maintained from 1896 to 1903. Records at this point show the amount of water carried by the river at the Nebraska-Kansas State line, and are of value in connection with irrigation above and flood control below.

No records have been obtained during the winter period. No storage is used on the stream to reduce floods or to reenforce the low-water flow, so that the variation in discharge is great. Owing to the unstable condition of the stream bed the records are more or less unsatisfactory.

The chain gage has remained the same since the establishment of the station. It is fastened to the bridge from which discharge measurements are made.

Discharge measurements of Republican River at Bostwick, Nebr., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 13	D. D. Price	270	227	1.70	345
May 18	E. C. Simmons	287	235	1.55	429
June 15	D. D. Price	265	159	1.40	238
July 12	A. A. Dobson	195	95	1.01	114
Aug. 13	do	225	100	1.10	110
Sept. 22	do	338	132	1.21	162
Nov. 5	do	275	150	1.34	215

Daily gage height, in feet, of Republican River at Bostwick, Nebr., for 1910.

[J. W. Keifer, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			2.75	1.8	1.55	1.5	1.1	0.8	1.8	1.7	1.2	1.5
2		3.2	2.95	1.8	1.45	1.45	1.1	.7	1.7	1.6	1.3	1.5
3		3.2	2.45	1.75	1.45	1.55	1.0	.7	1.6	1.7	1.3	1.5
4		3.15	2.35	1.75	1.45	1.55	1.0	1.6	1.6	1.6	1.3	1.6
5		3.15	2.65	1.7	1.5	1.55	1.0	1.3	1.6	1.5	1.3	1.6
6		3.05	2.85	1.7	1.6	1.45	1.0	1.9	1.5	1.5	1.3	1.8
7		3.0	2.5	1.7	1.6	1.5	1.1	1.4	1.6	1.5	1.3	1.8
8		3.0	2.45	1.7	1.55	2.1	1.0	1.5	1.7	1.4	1.4	1.8
9		2.95	2.25	1.75	1.55	1.75	1.0	1.2	1.5	1.4	1.4	1.6
10		2.75	2.25	1.75	1.6	1.7	1.0	1.2	1.5	1.3	1.4	1.7
11		2.75	2.15	1.7	1.6	1.6	.9	1.1	1.5	1.3	1.4	1.9
12		2.7	2.2	1.7	1.65	1.55	1.0	1.2	1.5	1.3	1.4	1.9
13		2.7	2.2	1.7	1.65	1.55	1.0	1.1	1.5	1.2	1.4	1.8
14		2.75	2.15	1.7	1.6	1.45	1.0	1.5	1.4	1.2	1.4	1.8
15		3.0	2.1	1.7	1.6	1.4	1.0	1.4	1.3	1.2	1.4	1.8
16			2.05	1.7	1.6	1 4	1.0	1.2	1.3	1.2	1.4	1.7
17		2.9	2.05	1.7	1.6	1.4	1.6	4.8	1.3	1.1	1.4	1.7
18		2.9	2.0	1.7	1.55	1.3	1.4	5.2	1.2	1.2	1.4	1.6
19		3.1	2.0	1.7	1.5	1.2	1.2	5.2	1.2	1.2	1.4	1.6
20			2.0	1.7	1.5	1.2	1.1	5.5	1.2	1.2	1.5	1.6
21		2.8	2.0	1.7	1.55	1.2	1.4	4.0	1.3	1.2	1.5	1.6
22			1.95	1.7	1.55	1.1	1.0	3.3	1.2	1.2	1.5	1.7
23		2.75	1.95	1.65	1.5	1.1	1.1	2.9	1.5	1.2	1.5	1.9
24		2.75	1.9	1.65	1.45	1.1	1.0	2.6	4.0	1.1	1.5	2.4
25		2.75	1.9	1.6	1.45	1.2	1.0	2.4	2.9	1.1	1.5	2.7

Daily gage height, in feet, of Republican River at Bostwick, Nebr., for 1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	.....	2.7	1.9	1.6	1.4	1.8	0.9	2.4	3.1	1.2	1.5	2.9
27	2.5	2.7	1.9	1.6	1.95	1.7	.9	2.2	2.5	1.2	1.5	2.9
28	.....	2.7	1.85	1.6	1.8	1.5	.8	2.0	2.4	1.2	1.5	2.9
29	.....	.....	1.85	1.55	1.6	1.3	.8	2.3	2.0	1.2	1.5	2.3
30	.....	.....	1.8	1.5	1.6	1.1	.8	2.3	1.8	1.2	1.5	2.1
31	3.25	.....	1.8	.....	1.55	.....	.8	1.8	.....	1.2	.....	1.9

NOTE.—Ice Jan. 1 to Mar. 10 and Dec. 1 to 31. There was a little ice Nov. 28.

Daily discharge, in second-feet, of Republican River at Bostwick, Nebr., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	400	345	275	125	60	440	380	160
2	.....	400	295	255	125	50	380	325	195
3	.....	375	295	300	100	50	325	380	195
4	.....	375	295	300	100	325	325	325	195
5	.....	345	345	300	100	195	325	275	195
6	.....	345	400	255	100	510	275	275	195
7	.....	345	400	275	125	235	325	275	195
8	.....	345	375	660	100	275	380	235	235
9	.....	375	375	410	100	160	275	235	235
10	.....	375	400	380	100	160	275	195	235
11	640	345	400	325	75	125	275	195	235
12	680	345	470	300	100	160	275	195	235
13	680	345	470	300	100	125	275	160	235
14	640	360	440	255	100	275	235	160	235
15	600	360	440	235	100	235	195	160	235
16	570	360	440	235	100	160	195	160	235
17	570	360	440	235	325	4,090	195	125	235
18	540	360	429	195	235	4,830	160	160	235
19	540	360	400	160	160	4,830	160	160	235
20	540	360	375	160	125	5,430	160	160	275
21	540	380	410	160	235	2,810	195	160	275
22	500	380	410	125	100	1,870	160	160	275
23	500	360	350	125	125	1,410	275	160	275
24	460	360	325	125	125	1,110	2,810	125	275
25	460	340	325	160	125	920	1,410	125	275
26	460	340	275	440	75	920	1,630	160	275
27	460	340	600	380	75	740	1,010	160	275
28	440	360	500	275	60	580	920	160	275
29	440	345	345	195	60	830	580	160	275
30	400	325	345	125	60	830	440	160	275
31	400	.....	310	.....	60	440	.....	160	.....

NOTE.—These discharges are based on rating curves applicable as follows: Mar. 10 to Apr. 13, not well defined; Apr. 14 to May 31, indirect method for shifting channels; June 1 to Nov. 30, fairly well defined between 100 and 200 second-feet.

Monthly discharge of Republican River at Botswick, Nebr., for 1910.

[Drainage area, 23,300 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
Mar. 11-31	680	400	527	0.023	0.02	22,000	C.
April	400	325	359	.015	.02	21,400	C.
May	600	275	388	.017	.02	23,900	C.
June	660	125	264	.011	.01	15,700	B.
July	325	60	116	.0050	.006	7,130	B.
August	5,430	50	1,120	.048	.06	68,900	B.
September	2,810	160	496	.021	.02	29,500	B.
October	380	125	201	.0086	.01	12,400	B.
November	275	160	239	.010	.01	14,200	B.
The period	.....	.....	.....	.....	.....	188,000	

BIG BLUE RIVER AT BEATRICE, NEBR.

This station, which is located at the highway bridge on Sixth Street, south of Beatrice, Nebr., on the section line between secs. 3 and 4, T. 3 N., R. 6 E. of the sixth principal meridian, 300 feet downstream from the railroad bridge and 1 mile downstream from a mill dam, was established October 15, 1910.

The chain gage used was installed by United States Weather Bureau on the upstream side of the highway bridge from which discharge measurements are made. Gage heights have also been obtained from this gage by the United States Weather Bureau for parts of years since 1905.

The constant angle between the bridge and the current renders it necessary to apply a correction coefficient of 0.8 to reduce the measured discharge to normal discharge past the cross section.

Miscellaneous discharge measurements were made at this location in 1908 and published in Water-Supply Paper 246, page 296.

No rating curve has yet been developed for this station.

Discharge measurements of Big Blue River at Beatrice, Nebr., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 13[a]	D. D. Price	80	137	.....	321
13	A. A. Dobson	150	250	2.62	382
Aug. 13	do	150	204	1.18	246
Sept. 22	do	150	247	1.38	400
Oct. 29	do	150	228	1.28	328
Nov. 11	do	150	223	1.35	324

[a] Made about 3 miles below in SW. ¼ sec. 7, T. 3 N., R. 7 E.

Daily gage height, in feet, of Big Blue River at Beatrice, Nebr., for 1910.

[Herbert Palmer, observer.]

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	.....	1.3	1.4	11	.....	1.3	1.4	21	1.3	1.3	1.3
2	.....	1.3	1.3	12	.....	1.3	1.3	22	1.3	1.3	1.1
3	.....	1.3	1.3	13	.....	1.3	1.3	23	1.3	1.3	1.1
4	.....	1.2	1.3	14	.....	1.2	1.3	24	1.2	1.3	1.1
5	.....	1.2	1.3	15	1.4	1.2	1.4	25	1.3	1.3	1.2
6	.....	1.2	1.3	16	1.4	1.3	1.3	26	1.4	1.3	1.2
7	.....	1.2	1.2	17	1.4	1.4	1.3	27	1.4	1.3	1.2
8	.....	1.2	1.2	18	1.6	1.4	1.3	28	1.4	1.4	1.3
9	.....	1.3	1.2	19	1.5	1.3	1.1	29	1.4	1.4	1.3
10	.....	1.3	1.3	20	1.4	1.3	1.2	30	1.4	1.4	1.2
								31	1.4	.....	1.2

LITTLE BLUE RIVER NEAR FAIRBURY, NEBR.

This station, which is located at the highway bridge 1½ miles south of Fairbury and about 12 miles above the Nebraska-Kansas State line, was established May 23, 1908, to obtain data for use in studies of run-off and flood control and in power development. A chain gage, the datum of which has remained constant, is fastened to the bridge from which discharge measurements are made.

Sandy Creek, the principal tributary, enters about 10 miles above. Muddy Creek, a small stream, is the only tributary between the station and the Kansas line.

The dam of the Fairbury roller mill is about 2 miles above the station, and may possibly cause some daily fluctuations in stage.

Gage heights are apparently little affected by ice.

Records have been fairly satisfactory, though the channel shifts at high stages. The maximum discharges are somewhat uncertain, as the river overflows its banks at about 11 feet gage height. The amount of overflow has been estimated.

Discharge measurements of Little Blue River near Fairbury, Nebr., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 29	D. D. Price	80	291	4.9	724
Mar. 2	do	70	164	3.6	350
Apr. 3	do	75	97	2.9	203
16	do	70	92	3.0	190
May 21	do	70	101	3.0	201
June 9	do	335	2,320	12.1	[a] 7,320
15	do	90	153	3.9	333
July 14	do	105	229	3.7	355
Aug. 7	do	72	94	2.81	168
Sept. 17	A. A. Dobson	75	86	2.71	137
Oct. 25	do	75	90	2.82	153
Nov. 11	do	75	96	2.80	151
Dec. 4	do	80	109	3.11	165

[a] Includes overflow of 600 second-feet at north end of bridge.

Daily gage height, in feet, of Little Blue River near Fairbury, Nebr., for 1910.

[Clark Hulburt, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.3	3.6	2.9	2.7	6.0	3.4	2.5	3.0	3.4	2.9	2.9
2		4.5	3.7	3.0	2.8	4.6	3.2	2.7	3.0	3.3	2.8	3.2
3		4.2	3.8	2.9	2.9	4.0	3.1	4.2	3.0	3.3	2.8	3.0
4		4.0	4.0	2.9	2.8	3.7	3.0	2.9	3.0	3.2	2.8	3.1
5		4.0	4.0	3.0	3.0	3.5	3.0	2.9	3.0	3.1	2.9	3.0
6		3.9	3.8	2.9	3.1	3.4	2.9	2.9	2.9	3.1	2.8	3.2
7		3.8	3.6	2.9	3.1	3.5	3.0	2.8	2.9	3.1	2.8	3.2
8		3.7	3.5	2.9	3.0	9.1	3.7	2.8	2.8	3.0	2.9	3.1
9		3.7	3.3	2.9	2.9	11.6	3.4	3.9	2.8	3.0	2.9	3.0
10		3.7	3.2	2.8	3.1	8.9	3.0	3.2	2.8	3.0	2.8	3.0
11		3.4	3.2	2.9	2.9	6.8	2.9	3.0	2.7	3.0	2.8	3.1
12		3.2	3.1	2.9	2.9	5.5	3.0	2.9	2.8	2.9	3.0	3.4
13		3.2	3.1	2.9	2.8	5.1	4.1	2.8	2.8	3.0	3.0	3.1
14		3.5	3.1	2.8	2.8	4.4	4.0	3.3	2.8	3.0	3.0	3.3
15		3.6	3.1	2.9	2.8	4.0	3.5	4.0	2.7	2.9	3.0	3.3

Daily gage height, in feet, of Little Blue River near Fairbury, Nebr., in 1910—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	.....	3.4	3.0	2.9	2.9	3.7	3.2	3.2	2.8	2.8	2.9	3.4
17	.....	3.5	3.0	2.8	3.0	3.6	3.1	4.1	2.8	2.8	3.0	3.4
18	.....	3.7	3.0	3.0	2.8	3.5	3.0	8.2	2.7	2.9	3.0	3.3
19	.....	3.8	3.0	3.0	2.9	3.5	2.9	5.7	2.6	2.9	3.0	3.0
20	.....	3.3	3.0	2.9	2.9	3.3	2.9	4.5	2.7	2.8	3.0	3.1
21	.....	3.7	3.0	2.9	3.0	3.3	2.8	5.4	2.8	2.9	3.0	3.1
22	.....	3.6	3.0	3.0	3.6	3.2	2.7	5.8	2.8	2.9	3.1	3.1
23	.....	3.7	2.9	3.1	3.2	3.2	2.7	4.6	3.6	2.8	3.0	3.3
24	.....	3.8	2.9	3.2	3.0	3.1	2.7	3.9	7.35	2.8	2.9	2.9
25	3.2	3.4	2.9	3.0	2.9	3.1	2.8	3.6	4.7	2.8	3.0	2.8
26	3.7	3.2	3.0	2.9	2.9	3.0	2.7	3.3	5.0	2.8	3.1	3.3
27	4.7	3.6	3.0	2.8	3.1	3.1	2.7	3.2	5.3	2.8	2.9	3.5
28	5.1	3.4	2.9	2.6	3.0	3.8	2.6	3.2	4.3	2.8	3.0	3.3
29	4.9	.....	2.9	2.9	6.0	4.0	2.6	3.2	4.0	2.9	3.0	3.4
30	4.7	.....	3.0	2.7	6.95	3.6	2.6	3.1	3.6	2.8	3.0	3.5
31	4.3	.....	2.9	.....	10.6	.....	2.6	.....	.....	2.9	.....	3.3

NOTE.—Ice probably existed to greater or less extent Jan. 1 to Jan. 24 and Dec. 12 to 31.

Daily discharge, in second-feet, of Little Blue River near Fairbury, Nebr., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	520	350	205	162	875	270	150	170	240	160	158
2	.....	580	375	210	172	390	240	160	170	230	151	220
3	.....	490	380	202	182	260	220	400	170	230	151	180
4	.....	440	440	200	172	210	210	180	170	220	151	165
5	.....	440	440	210	192	175	210	180	170	200	160	180
6	.....	400	380	197	204	160	210	180	160	200	151	220
7	.....	375	340	195	204	170	220	170	160	200	151	220
8	.....	355	320	194	194	2,800	330	170	150	180	160	165
9	.....	350	280	192	184	6,300	280	330	150	180	160	180
10	.....	345	260	180	204	2,740	220	210	150	180	151	180
11	.....	290	260	188	186	1,270	210	190	140	180	151	.....
12	.....	260	245	187	186	700	220	180	150	158	180	.....
13	.....	260	245	185	176	600	440	170	150	180	180	.....
14	.....	320	245	175	176	425	410	225	150	180	180	.....
15	.....	340	245	182	176	350	300	350	140	158	180	.....
16	.....	300	225	180	189	290	250	210	150	151	160	.....
17	.....	325	225	170	199	270	230	375	150	151	180	.....
18	.....	360	225	190	179	255	220	2,600	135	160	180	.....
19	.....	390	225	190	190	255	210	900	130	160	180	.....
20	.....	290	225	180	190	225	210	450	135	151	180	.....
21	.....	360	225	180	201	235	190	750	140	160	180	.....
22	.....	340	225	190	290	220	175	940	140	153	200	.....
23	.....	360	210	200	215	220	170	475	240	153	180	.....
24	.....	390	210	210	190	210	165	310	1,780	153	160	.....
25	260	300	210	190	175	210	190	260	470	153	180	.....
26	350	270	225	180	160	210	170	220	550	153	200	.....
27	640	340	210	170	190	225	170	210	660	153	160	.....
28	790	310	205	150	170	340	160	200	360	153	180	.....
29	724	.....	205	180	950	390	160	200	300	160	180	.....
30	650	.....	210	160	1,460	300	160	190	240	153	180	.....
31	520	.....	205	.....	5,050	.....	160	180	.....	160	.....	.....

NOTE.—These discharges were obtained by the indirect methods for shifting channels.

Monthly discharge of Little Blue River near Fairbury, Nebr., for 1910.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	[a] 320	19,200	D.
February	580	260	361	20,000	C.
March	440	205	267	16,400	C.
April	210	150	187	11,100	C.
May	5,050	160	412	25,300	D.
June	6,300	160	710	42,200	D.
July	440	160	225	13,800	C.
August	2,600	150	378	23,200	C.
September	1,780	130	264	15,700	C.
October	240	151	174	10,700	C.
November	200	151	170	10,100	C.
December	.....	.....	[a] 172	10,600	D.
The year	6,300	.....	303	219,000	

[a] Discharge estimated Jan. 1 to 24 and Dec. 11 to 31 because of ice conditions.

NOTE.—The mean for January is approximate.

MISCELLANEOUS MEASUREMENTS.

The miscellaneous measurements made in the Missouri River basin in 1910 are presented in the following pages. They have been listed under drainage basins in the same order as the regular stations:

Miscellaneous measurements in Missouri River basin.

Missouri River proper.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Nov. 22[a]	Missouri River	Mississippi River	Gaging station, Kansas City, Mo.	[b] 4.50	22,200

Upper Missouri River basin.

June 27	Red Rock River	Missouri	Lyons ranch, near Monida, Mont.	.....	66
July 6	.....do	.....do	.....do	.....	38
19	.....do	.....do	.....do	.....	38
30	.....do	.....do	.....do	.....	34
13	Sixteen Mile Creek	.....do	Lombard, Mont	.....	34
Oct. 1	Crow Creek	.....do	Townsend, Mont	.....	29
Sept. 9	Warm Spring Creek	Judith River	At mouth near Lewiston, Mont.	.....	142

Milk River basin.

Jan. 14	Milk River	Missouri River	Malta, Mont	.....	[c] 25
16	.....do	.....do	Exeter, Mont	.....	[c] 25
June 21	.....do	.....do	Chinook, Mont	.....	33
July 9	.....do	.....do	.....do	.....	35

[a] Made at Hannibal Railroad bridge near foot of Broadway, Kansas City, Mo. Measurement by G. L. Parker.

[b] Gage height referred to St. Louis directrix, which is 303.3 feet below the zero of the gage.

[c] Estimated.

Miscellaneous measurements in Missouri River basin—Continued.

Yellowstone River basin.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Sept. 10	Clark Fork	Yellowstone	Clark, Wyo.		244
10	Paint Creek	Clarke Fork	Near junction with Clark Fork, near Clark, Wyo.		7.8
10	Pat O'Hare Creek	do	Allison's Ranch, near Clark, Wyo.		5.2
22	Tensleep Creek	No Wood River	Above mouth of Canyon Creek near Tensleep, Wyo.		63
23	do	do	do		82
22	Canyon Creek	Tensleep Creek	At mouth, near Tensleep, Wyo.		24
23	do	do	do		29

Cheyenne River basin.

May 20[a]	Belle Fourche River	Cheyenne River	At cable station, 300 feet below diverting dam near Belle Fourche, S. Dak.	2.00	853
24[a]	do	do	do	1.06	321

Minor Missouri River basins in North Dakota.

July 21	White Earth River	Missouri River	At mouth, T. 153 N., R. 94 W.		[b] 2.5
Aug. 11	do	do	do		[b] 1.0
2	do	do	White Earth, N. Dak.		[b] 1.8
10	Shell Creek	do	Sec. 28, T. 151 N., R. 91 W.		[b] 2.5
10	Rising Water Creek	do	At mouth, T. 150 N., R. 90 W.		[b] 1.2
5	Little Missouri River	do	Sec. 5, T. 147 N., R. 92 W.		66
8	Douglas Creek	do	At mouth, T. 147 N., R. 85 W.		[b] 1.5

Niobrara River basin.

Aug. 30	Long Pine Creek	Niobrara River	2 miles west of Long Pine, Nebr.		50

Minor Missouri River drainage in Nebraska.

Oct. 26	Little Nemaha	Missouri River	Sec. 16, T. 6 N., R. 13 E., Brock, Nebr.		88

Platte River basin.

Sept. 1	North Platte River	Platte River	Keystone, Nebr.		52
Nov. 6	Laramie River	North Platte River	Laramie Poudre Co. Dam site near Glendevey, Colo.		[c] 3
Aug. 21	do	do	Boswell ranch near Jelm, Wyo.	1.00	42
Sept. 18	do	do	do	1.08	49
Nov. 8	do	do	do	1.00	41
9	East Fork of Lone Tree Creek.	Laramie River	2 miles west of Tie Siding, Wyo.		[c] 1

[a] Made by F. J. Barnes, U. S. Reclamation Service. [b] Made by floats. [c] Estimated.

Miscellaneous measurements in Missouri River basin—Continued.

Platte River basin—Continued.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge
				Feet.	*Sec.-ft.*
Nov. 9	Sand Creek	Laramie River	At highway bridge on road between Jelm and Tie Siding, Wyo.		a 2
8	McIntyre Creek	do	Measurement by wading 100 feet below old rod gage, Gleneyre, Colo.	1.15	4.5
7	Nun Creek	do	Just above mouth of Deadman Creek above Glendevey, Colo.		a 2.25
7	do	do	25 feet above mouth, Nun Creek, Glendevey, Colo.		4.9
8	do	do	do		5.2
7	Deadman Creek	Nun Creek	1 mile above Glendevey, Colo.		a 2.75

South Platte River basin.

Jan. 30	Buffalo Creek	North Fork of South Platte.	At Buffalo, Colo.		a 0.25
30	Elk Creek	do	Pine Grove, Colo.		a 2
Feb. 24	do	do	do		a 2
25	do	do	do		a 2
Mar. 27	do	do	do		a 4.5
30	do	do	do		a 7.5
Apr. 13	do	do	do		a 5.5
May 11	do	do	do		a 4
28	do	do	do		a 7
July 16	do	do	do		a 2
Nov. 19	do	do	do		a 3
Feb. 1	Deer Park Creek	do	Near Crossons, Colo.		a 4.5
25	do	do	do		a 3
Mar. 30	do	do	do		a 7
May 11	do	do	do		a 10
28	do	do	do		a 8
July 19	do	do	do		a 3
Aug. 30	do	do	do		a 4
Nov. 19	do	do	do		a 3
Feb. 1	Geneva Creek	do	At mouth Geneva Creek at Grant, Colo. Wading measurement.		15.0
Jan. 31	Three Mile Creek	Geneva Creek	Ice measurement just above mouth Three Mile Creek, near Sullivan's ranch, Grant, Colo.		1.9
Feb. 28	do	do	do		2.0
Mar. 29	do	do	Wading 100 feet above mouth. Near Sullivan's ranch, Grant, Colo.		1.65
May 10	do	do	do		2.4
29	do	do	do		3.0
July 18	do	do	Wading 100 feet above mouth Three Mile Creek, near Sullivan's ranch, Grant, Colo.		1.3
Aug. 29	do	do	Wading measurement 50 feet above mouth Three Mile Creek, near Sullivan's ranch, Grant, Colo.		1.9
Sept. 19	do	do	do		2.3
Nov. 19	do	do	Near Sullivan's ranch, Grant, Colo.		a 2
Oct. 7	Clear Creek	South Platte River	At bridge above mouth of South Clear Creek, Georgetown, Colo.		19.2
6	do	do	At highway bridge 4 miles above Silver Plume, Colo.		20.8

a Estimated.

Miscellaneous measurements in Missouri River basin—Continued.

South Platte River basin—Continued.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
July 23	North Fork of Clear Creek.	Clear Creek	Measurement by wading 200 feet above mouth. At Forkscreek, Colo.		3.7
Dec. 8	do	do	Measurement by wading 25 feet below C. & S. Ry. bridge, Forkscreek, Colo.		2.5
Oct. 9	do	do	1 mile above Smith Hill, Colo.		2.3
9	do	do	1 mile above Missouri Creek road and 4 miles above Blackhawk, Colo.		1.2
8	Chicago Creek	do	Above mouth West Chicago Creek, and 8 miles above Idaho Springs, Colo.		4
7	Fall River	do	2 miles above mouth Fall River, near Idaho Springs, Colo.		6.9
7	West Clear Creek	do	Just below mouth Mud Creek and 1 mile above Empire, Colo.		13.6
7	West Chicago Creek	Chicago Creek	At mouth West Chicago Creek, and 8 miles above Idaho Springs, Colo.		1.6
7	Mud Creek	West Clear Creek	At mouth Mud Creek, and 1 mile above Empire, Colo.		*a* 4
Nov. 6	Cache la Poudre River	South Platte River	Just below Chambers Lake Outlet, Colo.		14
9	Dale Creek	North Fork of Cache la Poudre River.	Near Virginia Dale, Colo.		*a* 2
5	Roaring Creek	Cache la Poudre River	Near mouth Roaring Creek, about 2½ miles above Home, Colo.		*a* 2
5	Trap Creek	do	Just below Chambers Lake, Colo.		*b* 1.0
5	Joe Wright Creek	do	Chambers Lake, Colo.		*b* 4.0
5	Fall River	do	do		*b* 1.5
5	Big South Creek	do	At mouth, 11 miles above Home, Colo.		8.2

a Estimated.

b Float measurement.

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